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For Stricter Scrutiny

IN ORDER TO SECURE more definite information regarding the qualifications of applicants for membership and to be able to check the applicant's statements as to his experience, the American Society of Civil Engineers has adopted the new form of application blank illustrated on page 673. The characteristic feature is the provision for detailed tabulation of the applicant's professional record as to character, dates and length of engagement. Moreover, the applicant must refer to someone (not necessarily a member of the society) familiar with each engagement, preferably the person to whom he reported. In this way the society will be able to check the estimate placed by the writer on the character of his own experience. The reference to at least five corporate members of the society will still be required. The step taken by the board of direction in devising this new form is a highly commendable one. In the past, merely the reference to five corporate members was necessary, and these members might have little or no knowledge of the character of the applicant's work. It was not necessary that they should have had professional contact with the applicant. The rules as to reference to corporate members have not been changed, but the provision that requires of each applicant reference to someone familiar with each of his engagements will enable the society to learn with exactness the character of the experience which he offers as his qualification for membership.

Planetable for Railroads

THE successful use of the planetable in mapping a large railroad yard to meet the requirements of the government in connection with the valuation of the railroads is described by R. E. Davis on page 674. The article should be very suggestive to railroad men. Mr. Davis puts his finger squarely on the weaknesses of the tape-and-transit method. Where the notes are to be plotted in the office it is, as Mr. Davis states, necessary to get and record "extra information" to make the notes intelligible, even when a member of the survey party plots the notes, and by the same token it is highly probable that important data will "turn up missing" during the plotting. And under the policy of some roads of having the surveys made by men ignorant of what they will be used for, and the notes in turn plotted by men who have never been on the ground, it is almost inevitable that there be several attempts made in the field, with great loss of time, before the map is complete. For one-day or two-day surveys the planetable would probably be too cumbersome to haul around, and, too, the transit can be worked in weather that would drive the planetable to cover. But for surveys of greater length, made in fair weather, the planetable seems to possess many advantages, and it is to be hoped that it will be given a trial.

Conservancy Plans Approved

IT WILL BE good news to those who have watched the long struggle of Dayton and adjoining communities to embark on plans for safeguarding themselves from flood damage to know that the conservancy court has approved the plan proposed by the engineers of the Miami Conservancy District, headed by Mr. Morgan as chief engineer. As those who have followed the history of the development in this journal well know, a most strenuous fight has been made against the detention basin plan. The original attack was made not upon the plan itself, but on the conservancy law under which the Dayton scheme was to be carried out. The constitutionality of the measure was attacked, but was finally sustained by the Ohio Supreme Court. Now the conservancy court, consisting of a judge from each of the nine counties into which the district extends, after hearings lasting from Oct. 6 to Nov. 24, has made the detention-basin scheme official and the real work of making the dirt fly comes measurably near. The plan provides for the construction of five "dry" reservoirs, combined with a certain amount of channel improvement, as was described in the Engineering Record of March 28, 1914, page 356, and March 11, 1916, page 348. The decision should be of general interest, for it establishes for the first time widespread co-operation in handling floods. Dayton and its associated communities have fought valiantly for the correct solution of this great engineering problem. The men who have directed the fight deserve to be congratulated on the successful issue of their efforts.

To Fight Water Waste

IF WATER-WASTE prevention plans of a small but influential body of Chicago engineers can be put into effect, that city will soon be able to curtail its 65-per cent loss and have something constructive to report to the New England Waterworks Association's water-waste committee. The matter was recently brought to the attention of subdivision 63, the engineers' subdivision, of the Chicago Association of Commerce in the form of an address by John E. Ericson, city engineer. That steps should be taken at once to stop the waste was conceded. A mere recital of statistics was cause for action. The prospective saving of water and of dollars commended itself to railroad chief engineers and consulting electrical engineers accustomed to the sale of transportation or current by measure only. Municipal engineers needed no argument to convince them of the merits of the project. In consequence a committee was appointed, not to investigate metering, underground leakage or any other technical subject, but to discover ways and means and to formulate a campaign of education through the Chicago Association of Commerce, and bring the weight of that organization to bear on the public and officials. The committee is headed by C. W. Morse, chief engineer of the Chicago, Rock Island & Pacific Railway. Other members are W. B. Jackson, Isham Randolph, John W. Alvord and Dabney H. Maury. consulting engineers. Results of value should follow the committee's work. Other municipalities might well adopt the Chicago method.

Safeguards at Movable Bridges

FOLLOWING the two recent serious accidents caused by defective safeguards at movable bridges, one in Chicago, where four people were killed when an automobile plunged into the Chicago River at an open drawbridge on Twelfth Street, and the other in Boston, where nearly fifty passengers were drowned when an electric car ran through the gates at the Summer Street drawbridge and fell into the Fort Point Channel, exhaustive investigations of the whole subject of proper safeguards at such bridge openings have been made. As briefly noted in the news pages of this issue, the investigating commissions independently arrived at similar recommendations. Of the two reports, however, that of the Chicago commission is much more drastic in its proposals. Its recommendations include strong illumination of the approaches, special stop signals and bells, the installation of double safety gates instead of a single gate (one a light signal gate and the other a barrier gate sufficiently heavy to absorb the impact of moving vehicles), interlocked with the bridge-moving mechanism to insure a positive stop when the bridge is open. Interlocking gates are also specified by the Massachusetts Public Service Commission; or, in case they are impracticable, a "smash-board" signal must be provided at a reasonable braking distance from the opening. The interlocking device specified in both cases requires that bridge operation shall be impossible unless the gates are in position. Bridge engineers will be interested in these requirements, and doubtless will contribute their share toward the solution of the practical difficulties which will arise.

Settling Labor Disputes in Public-Service Utilities

A WAGE commission to settle disputes between public-service corporations and their men was proposed last week before the Academy of Political Science by Oscar S. Straus. The commission would be vested with full power to enforce its findings. Mr. Straus supported his views by carefully marshaled arguments in which the responsibility of both operators and employees to the public was brought out, and repeated the indisputable reason for depriving men engaged in public service from exercising the right to strike. Since on this point—the compulsory power of the commission proposed by Mr. Straus—labor would make most serious objection, attention is directed particularly to it.

Mr. Straus made it clear that employment in this class of work is in a different category from that in strictly private enterprises. Public-utility companies stand in a special relation to the general public. In return for performing a quasi-public function they are vested with monopolistic rights. But this relationship carried with it the contract to render, within reasonable limits, such a service and at such rates as the public shall lay down. In other words, in return for what it gets from the public the public utility must give up certain rights which inhere in the operation of a strictly private enterprise.

What applies to the public-utility company must also extend down to its operatives, for the utility is a dead thing and of no value to the public unless, in addition to material equipment, it has the necessary men to keep it going and to perform the service for which it has been established. The employees necessarily, therefore, must subordinate themselves to the public good. They must, as Mr. Straus said, give up some of their group rights. They may as individuals leave the service of the company, since the resignation of an individual—provided the resignation is truly an individual action—can have little or no effect in curtailing the service to the public. But if the men give up some of their group rights they are entitled to compensation. The things which they may legitimately demand in return are, in Mr. Straus' opinion, exceptional wages and conditions of service.

Two controlling theses must, therefore, be borne in mind—one by the public and one by the employees. The public must admit that in return for the surrender of certain rights the employees must have compensating advantages. The employees must concede that their service is "affected with a public interest," and that the right to strike, to make the public suffer, must be given up by those who engage in service with a public-utility corporation.

From the practical standpoint it is interesting to know that Mr. Straus will shortly, on behalf of the Public Service Commission of the First District, New York, of which he is chairman, initiate hearings on the advantages and disadvantages of his plan, to the end that a bill may be formulated and introduced into the New York Legislature at the coming winter's session. Should it prevail, an opportunity will be afforded to find the actual workings of the scheme. But whether it materializes now or not, the plan is based upon sound reasoning and deserves the thoughtful consideration of those who are concerned with the public-service labor problem.

Overdoing Standardization

IT is generally agreed that the adoption of standard shapes and sizes in many branches of engineering tends to economy and convenience. Experience shows, however, that one can easily go too far in trying to reduce the design of a screw, a machine or a building to a general typical average. For example, no instance of standardization is better known or is more useful than that of machine screws. The gain in interchangeability is very great, yet there is no particular use in the reductio ad absurdum which would follow an attempt to carry the same rules for the relations of form, pitch, and diameter into jack screws for wrecking cars, or the almost invisible product of the watchmaker. Such special articles gain nothing in forming a part of a generalized scale.

Articles for common interchangeable use should conform to standard relations. Those which have no possible connection with such a scale may as well be one thing as another, provided they are adapted to their particular uses and agree among themselves so far as is convenient. In other words, standardization is good so long as it actually tends to general convenience, but it ceases to be good when it leads to the adoption of a thing imperfectly fitted to its use for the sake of being perfectly fitted to agreement with something quite different. Special operations require special tools, and the economy of these operations depends on the adaptation of the tool to its use.

These minor examples of screws and tools, however, are only a few that come under the general principle that care must be exercised lest in the attempt to secure uniformity and symmetry these qualities are obtained at the expense of usefulness. In bridges, for example, standardization may tend to simplify construction, but it may or may not lead to a finished product of maximum fitness for its purpose. In other words, standardization, either in machine screws or bridges, is a good and convenient thing, provided it is not attempted to push it over too wide a range. Many a machine and many a structure has suffered from an obsession of symmetry on the part of the designer, or from an attempt to use standard sizes and shapes where they lead to inconvenience. What would happen if there were an attempt to adapt all milling machines to a set of standard cuts and to dragoon all machine designers into the use of these cuts for the sake of uniformity in the tools. Experience has taught that to perform certain operations in the most efficient manner special machines and tools are necessary, and in the long run pay many times over for their deviation from standard practice in general machine-tool design.

The long and short of the matter is that common sense lies back of standardization and its limitations, for standardization is a means to an end, rather than an end in itself. It is immensely convenient and economical within a certain range; outside of that range it may become a serious handicap to efficiency.

The Camera on Engineering Work

DURING recent years the camera on engineering work has come to be regarded not as a plaything but as a decidedly useful adjunct to field equipment. On such great projects as the Panama Canal, the Catskill and Los Angeles aqueducts, the Reclamation Service developments and on all of the big railroads, it is common to employ a staff photographer who devotes his entire time to picture-taking.

Engineers themselves, however, have failed to take full advantage of the small hand camera on their own work. Picture-taking with the hand camera of to-day has been developed into an exceedingly simple process—so simple in fact that many people believe that the mere squeezing of a bulb or the pushing of a lever is the only thing to think of. There is much more to it than this, as the reader of Mr. Campbell's article on page 670 of this issue will discover. While he gives some valuable advice regarding the selection of cameras, shutters and lenses, one of the most interesting parts of his paper is that which deals with the composition of a picture. What will the picture show? This is the question which every camera user should ask himself before exposing a film. By attempting to visualize the finished print, the taking of many useless pictures will be avoided.

It is highly important to have the camera in the right position to show what is wanted. Very often the interesting feature is not the entire structure, but some detail of it. As a rule, engineer-photographers entirely overlook this important point. Thus, if the structure be a dam of standard type, the real point of interest might be not the dam itself, but some detail of the outlet gate or gatehouse. Let the photographer therefore get a "close-up" of this feature rather than a landscape view, in which such a detail would be lost.

Of course, every camera user develops hobbies of his own and it is fair to assume that everyone will not agree with everything that Mr. Campbell has to say. Thus, Mr. Campbell places very little value on exposure meters, designed to indicate to the user the proper timing of his exposure, while certain other camera users regard them as indispensable. Then, too, Mr. Campbell says that only by learning how to develop negatives and to make prints can the camera user school himself in making correct exposures. A great deal of evidence could be brought forth to controvert this statement. Nevertheless, a knowledge of developing and printing is exceedingly valuable to the camera user. It is not, however, essential for the taking of good pictures.

There are so many ways in which the camera can be used to good advantage in recording progress or special features of engineering work that more men should own the smaller machines—those which may be carried around on the job with little or no effort—and learn the proper way to use them. Every picture taker is at a loss, sometimes, to know why his photographs do not turn out well. After reading carefully what Mr. Campbell has to say his percentage of failures should be reduced to a negligible quantity.

Railway Rates and Wages—Here and Abroad

WITH one exception in each case the railroads of the United States in 1913 paid their employees the highest average yearly wage and charged the lowest average ton-mile rate in the world, according to statistics compiled for thirty-eight countries and states by the Bureau of Railway Economics. In Western Australia the average compensation was about 6 per cent more than in the United States, and in India the average ton-mile charges were slightly (4 per cent) less than in this country. In Western Australia the ton-mile charges are double those of the United States; in India wages are very low.

Unfortunately there are gaps in the figures, owing to the inability of the bureau in some cases to obtain comparably acceptable information, so that it is impossible to draw a complete parallel between the United States and the principal European countries. The average compensation in this country of $756.83 compares, however, with corresponding figures of $408.97 for Germany, $376.81 for Italy and $211.40 for Russia, neither France nor the United Kingdom being given. On the other hand, while the table of ton-mile charges does not include either Italy or the United Kingdom, the figure for the United States, 0.729 cent, may be compared with 1.244 cents for Germany, 1.183 for France (in 1912) and 0.933 for Russia. Japan's average ton-mile charge was only 0.774 cent, but the average compensation was only $112.56.

If we were to make up a new figure, average yearly compensation per one cent charged per ton-mile, for the countries in which both average compensation and average ton-mile charges were known, we would get the following: United States, $1,038; Canada, $855; New South Wales, $388; Germany, $329; Sweden, $298; Holland, $275; Hungary, $247; Russia, $227; Austria $223; Rumania, $192; Japan, $145, and Switzerland, $139. While this is perhaps a fantastic unit it seems to show rather well how the employees fare in proportion to the unit freight returns, and it is seen that in this respect only our neighbor on the north is at all in the running with us. Of course both the relatively long haul and the large percentage of low-grade freight in the United States tend to keep down the rate per ton-mile. The high compensation can probably be attributed to our large cars and long trains, making it possible to use comparatively fewer men and pay them better. But however analyzed, it is hard to make the figures reflect other than credit to the American railroad.

A Lesson in Efficient Convention Management

THE CONVENTION of the City Managers' Association at Springfield, Mass., last week did more than furnish a fund of valuable information on the conduct of public business under this comparatively new form of municipal administration. From city managers we have been led to expect efficient methods of doing things—the substitution of direct for roundabout procedure. These expectations were fully realized in the handling of the Springfield meeting. Lost motion, the bane of nearly every engineering gathering at which papers are presented or discussed, was eliminated. Interest was always well sustained. Discussion was participated in freely. Addresses were terse and to the point. The program gave evidence of intelligent advance planning by President Henry M. Waite, city manager of Dayton, and his associates, and the proceedings throughout ran with clocklike precision.

It is high time for other engineering organizations to realize the importance of efficient convention management and to apply the principles which the city managers used so effectively at their annual meeting last week. We have had enough of programs in which business and technical sessions, banquets, trips of inspection, election of officers, selection of place of meeting and a varied assortment of entertainment features are thrown pell-mell into a program which soon becomes a veritable grab-bag of uncertainty.

An analysis of the city managers' program makes an interesting study, and one from which a moral may be drawn. Apparently it was prepared upon what might be termed the budget principle. Those who had charge of it grasped the vital point that the convention had a definite amount of time to spend. With this factor known, addresses and discussions were scheduled to consume this time and no more. Every hour was definitely accounted for. For example, the program for one afternoon was as follows: 2 p. m.—"Can a City Manager Succeed Where the Commission Is Dominated by Politics?" (general discussion); 3 p. m.—"Best Method of Keeping Cost Records" (general discussion, 5 minutes to each member); 4 p. m.—"The Best Method of Getting Proper Constructive Publicity" (discussion, 5 minutes to each member); 7 p. m.—dinner (roundtable discussion), Room A, "What City Managers Can Do to Further Advance Good Government," Vice-President Barnwell presiding.

It is so simple to build a program which will definitely utilize the time available that it is hard to understand why the practice does not become universal. Slavish adherence to precedents of former years, not applicable to-day, and the inertia of secretaries and local committees are responsible in large part for present conditions in other engineering organizations.

But it is one thing to prepare a program and another to have it proceed as arranged. Much depends on the presiding officer. A far too general conception of his duties seems to be merely the occupation of a chair on the rostrum. The most carefully prepared program can be knocked into the semblance of a crazy-quilt by a well-meaning but incompetent presiding officer—one who takes no heed of time and goes to the extreme either of letting discussion run wild or of doing absolutely nothing to stimulate it when it lags. The Springfield meeting of the city managers was fortunate in having Mr. Waite in the chair. If discussion on a certain subject was scheduled for 3 o'clock, it took place at 3 o'clock and not 10 o'clock the next morning or the morning after that. If there was a man in the audience qualified to express an opinion he was called upon by name. Bits of information from the presiding officer's own experience were given to keep things moving. But most important of all, there were no postponements of addresses and no omissions. Everything proceeded with businesslike dispatch. The disgruntled author of a paper and the disappointed auditor, figures not unknown at other conventions, were nowhere to be found.

Is it worth while to have conventions of this sort? Ask the man who goes to a meeting to hear a certain paper on a certain day and then discovers that it has been postponed or entirely eliminated. Ask the author whose paper is "read by title" because, through lack of advance planning, there is no opportunity for giving him a hearing. Ask the specialist who is urgently invited to be present to discuss a subject and who arrives upon the scene only to find that there is to be no discussion. Some men can afford only a day's time at a convention. Imagine their chagrin when they reach the meeting and discover that the paper they wanted to hear, scheduled for a specific day, had been arbitrarily advanced on the program to take the place of something else the day before.

There is a constructive lesson to be learned from the Springfield meeting of city managers. It is the lesson of getting the most out of engineering conventions by advance planning and efficient conduct of meetings. Too often it happens that a zealous secretary, intent upon making a big showing in the program for his convention, sends out broadcast to engineers requests for technical papers and discussions. No thought is given to the amount of time available for disposing of this material at the meeting. The main point seems to be to secure as many papers as possible and then to unload upon the meeting "as much as the traffic will bear." This kind of procedure defeats its own ends. It is merely another case of "ambition o'erleaping itself." If it continues long, engineers will be reluctant to prepare papers for conventions unless they can be guaranteed a hearing. It is the business of the convention management to issue this guarantee in the form of a program, prepared on the budget principle, which takes into account the amount of work to be done and the amount of time available in which to do it. Recognition of this fundamental fact made the convention of the City Managers' Association an unqualified success.

Camera's Use on Engineering Work Worth Learning

Technique Can Readily Be Mastered—Choice of Lens Important—Care Should Be Given to the Composition of the Picture—Don't Underexpose Films

By H. COLIN CAMPBELL
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STATISTICS have been compiled for all offenses except those committed in the name of photography. When the census taker makes his rounds to tabulate criminal offenses he can secure a great many of the necessary figures from the engineering and contracting professions. With his mind trained to do precise work there is really no excuse for the engineer being such an indifferent photographer as he often is. This art-science would serve him well if he were willing to devote a little systematic study to the subject and to graduate from the ranks of button-pushers. He should not let any one "do the rest," for only by doing all himself can he learn why the plates or films that he has been having developed by some one else have turned out unsatisfactorily. Only by mastering the mechanics of photography, which may be easily learned and applied, can he hope for success.

BEST TYPE OF CAMERA

For all-around purposes in the field, no other camera, where the user must be limited to one which can be carried handily, will serve the engineer-photographer in so great a degree as one of the folding types of 3¼ x 4¼-in. size, or thereabouts. Sharp negatives made with this camera can be enlarged to 8 x 10 in. or larger if desired, and at less expense than will result from using a larger camera exclusively, since one does not always need the larger pictures. This should be equipped with one of the high-grade lenses of the anastigmat type, working at a speed of about F6.8. This designation means that the ratio between working aperture of the lens and its focal length is as 1 in. to 6.8 in. In other words, a lens is known as an F8 lens if the working aperture is 1 in. and the focal length 8 in. A lens of 16-in. focal length, for instance, that worked at F8 would have a 2-in. aperture.

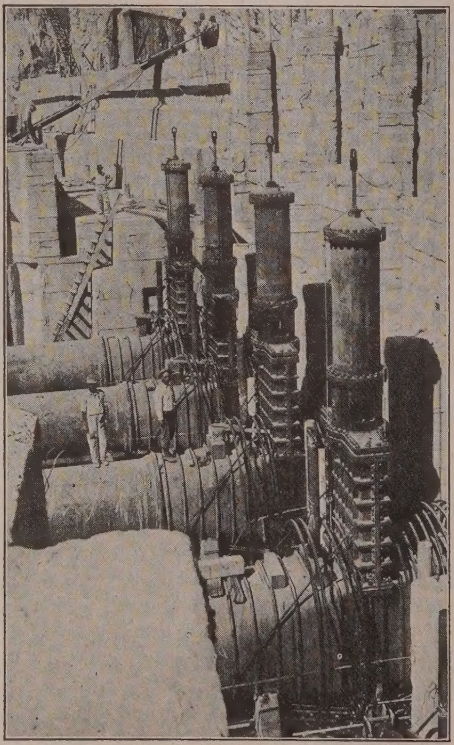
LENSES

Lenses are mounted in shutters equipped with what is known as an iris diaphragm, which permits reducing the working aperture of a lens as may be necessary to compensate for conditions of intense light, to increase the sharpness of the image over the plate or film and to increase the depth of focus of the lens. Depth of focus is a term used to describe the property which a lens has of defining with equal sharpness objects both near and far from the position from which the camera is used while taking a picture. Depth of focus is dependent, in the first instance, upon a number of conditions. Lenses of long focal length have relatively less depth of focus than lenses of short focal length. For instance, a lens of 2-in. focus, such as used on motion-picture cameras, will, so far as the eye can detect, define objects from 8 or 10 to 100 ft. distant from the camera with equal sharpness when the lens is used at its full working aperture. As the focal length increases, however, depth of focus diminishes. This is why lenses or shutters in which lenses are mounted are equipped with an iris diaphragm.

Closing this diaphragm, or, as it is called, "stopping down the lens," increases the depth of focus, and in some cases—that is, in lenses of the rectilinear type—increases sharpness of the image all over the plane of the plate. Rectilinear lenses, however, are not now commonly used, the modern anastigmat lens having taken its place. This lens eliminates many of the optical errors that were inherent in the early types. Even at full aperture it will reproduce or define straight lines, both vertical and horizontal, truly straight and sharp to the limits of the plate. There is not sufficient space at our disposal to define all of the technical requirements of a good lens. These can readily be learned from the catalog of a lens manufacturer.

PICTURES AS RECORDS

Photography properly applied enables the engineer to record progress and all details of construction on any piece of work, gives him a check on memory, and records details that are hidden in the finished structure. Not every negative that may be made is likely to possess a distinct value. There is more to photography than the ability to secure a sharp, photographically good negative that will yield equally good prints.



SIZE SHOWN BY CONTRAST

Massiveness of these large gates in the Arrowrock Dam is clearly disclosed by having human figures standing in the picture near the gates. One thereby gets a correct idea of size. No one will claim that great care was used to construct forms so that smooth concrete faces would result. The reverse is quite evident from the microscopic detail in the picture, which is so faithful as to show the ends of wire ties used. This exposure is from a correctly timed negative made in very strong sunlight.

To be of value to the engineer on construction, a picture should serve as a useful record of some particular piece of work or some stage of progress of that work; or perhaps record some practical operation or a scientific fact.

Those who practice photography to-day have little knowledge of the disadvantages under which the early photographic worker labored. Carrying around the cumbersome outfit with necessary paraphernalia to prepare wet plates immediately before the exposure could be made, and usually the possibility of losing some associated incident that it would have been very desirable to record, because of lack of speed in plates and lenses, made such photography quite different from pushing the button. It is unfortunate, however, that many are tempted, through the very ease of operating the modern camera, to take "snapshots" of everything, right and left, without a display of the discriminating judgment necessary to choose subjects or opportune moments for the true value which the proper record would have. As a result many photographs are made which although technically good have no value for practical purposes.

WHAT WILL THE PICTURE SHOW?

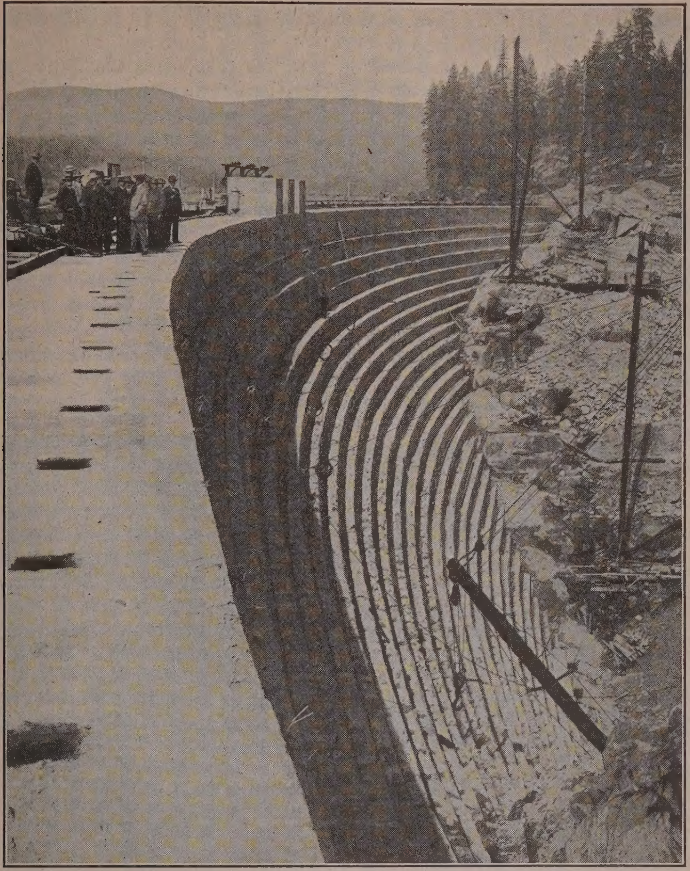
Among the questions which the camera user should ask himself before taking a picture are the following:

Is the picture merely a repetition of one already made? If it is, would there be any useful purpose served by taking it from a different viewpoint? Will the photograph illustrate fully some fact or process, some point of progress, or does it simply show a group of workmen or bystanders posing for their portraits? What will the picture show by itself; or will it be of advantage only when made a part of a series? Many photographs which are taken show one stage of a very interesting operation, but only one, therefore by themselves are practically useless. When the camera user has asked and carefully answered for himself these questions, much of the "snapshotting" will be eliminated.

Pictures intended to arouse popular interest—that is, to have strictly a news value—may quite properly, in fact should, possess different qualities or display different composition from that which is desirable in a photograph made solely for scientific record. In the latter case the object of taking the picture should be kept uppermost in mind and no other considerations be allowed to interfere with the clearness and accuracy of the record. For news value, animal life gives human interest, but nothing does more to mar an engineering picture than to see workmen on a job grouped and posed solely for the purpose of having their portraits taken.

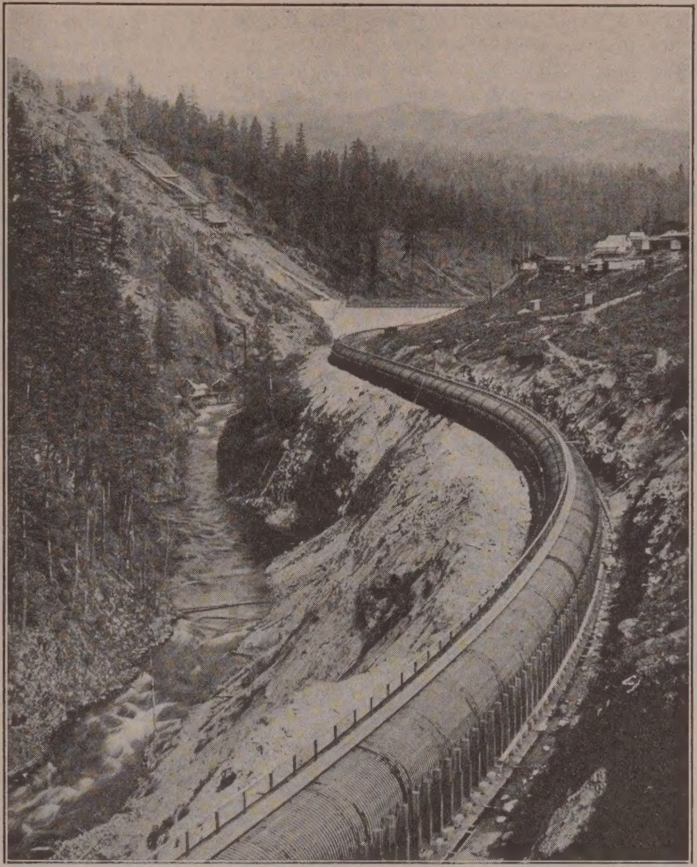
News interest is enhanced by action, but action is not expressed where workmen are resting on their shovels, directing a fixed stare toward the camera.

Many "attachments" have been invented and marketed with a view to impressing



WHERE POSITION OF CAMERA COUNTS

In this photograph, showing a portion of the Big Creek dam, immensity is at once suggested by the looking-downward point of view. The group of figures gives one an idea of the dam's thickness, while the figure of the man standing on the fourth "step" helps one to grasp the total height of the structure. If the camera had not been pointed downward, as it was when taking this picture, length instead of thickness and height would have been the impression first conveyed.



LANDSCAPE AND ENGINEERING ARTISTICALLY COMBINED

Flow line and dam, conduit plant of the Northwestern Electric Company, Portland, Ore. The point of view is so high that the monstrous serpent-like pipe seems almost to fit rather than mar the landscape. Had the view been taken lower down so as to exaggerate the size of the pipe, the landscape setting would have been subordinated. A "picture" would have thus been lost. Unfortunately, modern periodical printing methods are such as to prevent even the finest halftone from showing all the fine details of an original.

the camera user that success depended upon hanging all of these on his outfit. Nothing could in general be farther from the truth. One should not experiment with ray screens, telephoto lenses, back combinations, etc., without knowing just what the result will be. It is surprising what excellent work can be turned out with the old types of rectilinear lenses in the hands of persons who know how to use a camera. In fact, one is safe in recommending that unless the camera user is willing to devote enough practice and study to picture-taking—to the mechanics of photography—to become relatively expert, he can hope for just as good results, if not better, from a camera equipped with a rectilinear lens as from one of the speedy modern anastigmats.

SPEED OF LENS

Speed of lens, as has been suggested before, depends on the relative working aperture. A lens which works at F4.5 at full aperture can be slowed down so as to compel greatly increased exposure, by closing the lens or shutter diaphragm. The amount of exposure necessary then depends on the degree this aperture is diminished and is in direct ratio to the area of the aperture (circle) compared with full aperture.

By far the greater number of photographic negatives are under rather than over exposed. Detail cannot come from underexposure, nor can any of the laboratory or darkroom makeshifts, such as intensification and similar manipulations, bring out an image which has never been impressed on the plate by the chemical action of light. A fully timed or even an overexposed plate or film—if such condition is known to have existed—can be manipulated to almost any reasonable degree with good prospects of satisfactory results. A correctly timed negative can be developed in almost any kind of photographic developer with the assurance that the resulting picture will be all that could be desired. Even the faulty negative may have some of its errors compensated for through the wide latitude offered in the great variety of printing papers now on the market. Of course, what is not there cannot be manipulated nor shown.

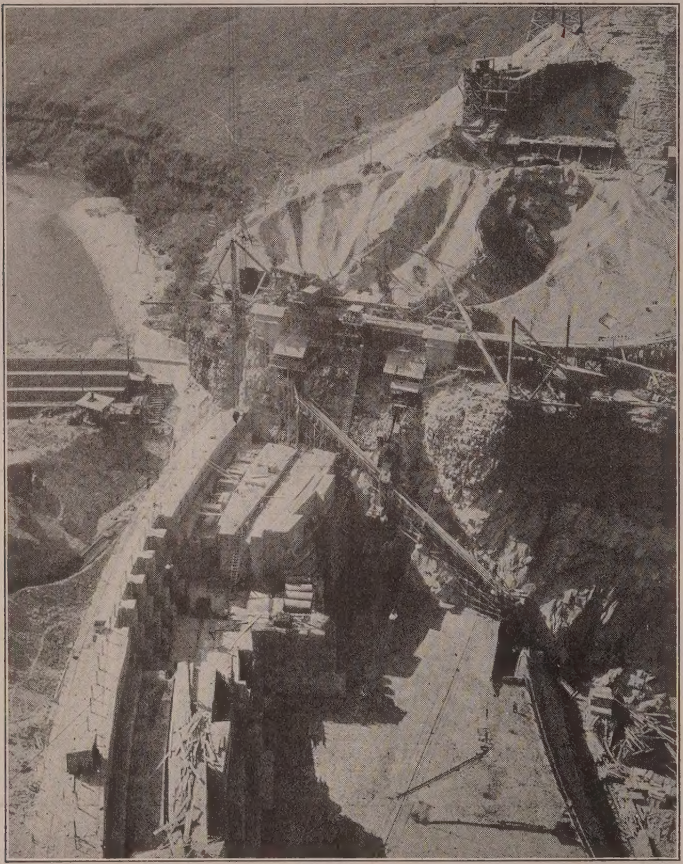
Sometimes absolute sharpness of detail is essential under conditions where rapid exposure must be made. Then the result may best be secured with a camera having a lens of relatively short focus, since, as already mentioned, such lenses define objects near and far from the camera with apparently equal sharpness. If lenses of too short focus are used, however, perspective will always be distorted. Lack of sharpness impairs the value of a picture for illustration and record.

Several objections to the small cameras not easily remedied might be mentioned. Little dependence can be placed on the viewfinders with which such cameras are supplied. They serve a certain purpose well; that is, they enable the photographer to know whether he has an object nearly centered on the plate or film. But as finders do not occupy the same position that the lens does, their point of view is that much different so they do not "place" the object exactly as the lens will. Also, the angle of view of camera finders varies, and rarely or never is this angle of view the same as that of the lens. The finder may include more or less of a scene than will be actually recorded by the lens. In photographing near objects, all finders are practically worthless. Then a ground-glass screen and focusing are necessary. The erratic "reading" or indications of finders are responsible for many photographs failing to show certain parts of a view that it was thought was being included in the picture.

REFLECTING TYPE OF CAMERA

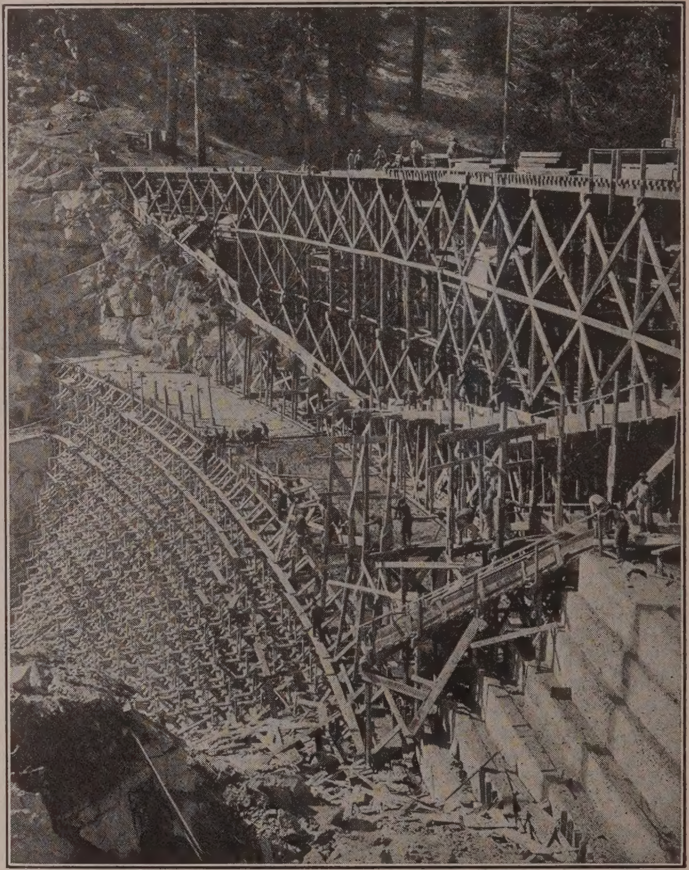
Cameras of the reflecting type display the image on a ground-glass screen right side up and permit instant adjustment of focus. Pictures made with them are certain to be sharp, while those taken with a camera where a focusing scale is used depend for sharpness largely upon the ability of the camera user to guess distances correctly. Errors of estimating distances are not so noticeable where the objects being photographed are 50 ft. or more distant from the camera and the lens is slightly stopped down, as then the depth of focus is increased and errors of focusing concealed; but as the camera is brought nearer to the object, then any errors of estimating distance become much more noticeable and cannot always be corrected by stopping down the lens. This is especially true when the camera is held in the hand, as a long or slow exposure is impossible because of the certainty that the camera will be moved while the shutter is open.

Properly used, the reflecting types of cameras serve a better purpose for all-around photography than any other type now made. They eliminate absolutely the guessing of distances. The picture is seen right side up on the focusing screen to the moment of exposure, although of course reversed; and where motion must be arrested—that is, where the scenes of real life and action must be taken—the focal plane shutters used in these cameras permit of such a wide range of speed that to all appearances motion can be absolutely arrested. These shutters consist of a curtain having slots of various widths in them, and passing immediately in front of the plate admitting for the entire length of the exposure a uniform volume of light over the whole plate. The main objection to the reflecting camera is its bulkiness as compared with a folding camera.



VIEW REMARKABLE FOR MAGNIFICENT DETAIL

A photograph of the Arrowrock Dam looking down from a point near the spillway. This picture has an exceptionally pleasing sparkle of light and shadow. The point of view helps the suggestion of massiveness and magnitude. At the time of taking this picture the sun was to the right and front of the camera. Such conditions require that care be taken to shade the lens, and particularly to make certain that full exposure is given.



FORMWORK DETAILED BY PHOTOGRAPH

Formwork on Big Creek Dam No. 3, Pacific Light & Power Corporation. Another remarkable construction view which almost details formwork to the careful observer. This picture also was taken with the sun slightly in front of the camera, yet notice that exposure has been sufficient to show detail under the trees in the distance and almost inside the intricate maze of form timbers. Some of the clearness, of course, is lost in reproduction.

DON'T USE HIGHEST SPEED

Many persons who have high-grade cameras equipped with high-grade lenses and speedy shutters cannot school themselves against the tendency to use the apparatus at its highest possible speed. If their camera shutter is rated to work at a possible two hundredth or three hundredth of a second, they think that they are losing money unless they take full advantage of the feature. This is responsible for the large majority of underexposed negatives.

"Exposure meters" are made in varieties galore in the attempt to offer the camera user a means of determining correct exposure under many conditions. Experience has proved that some of these devices are of questionable value, all are largely of theoretical value only. Nothing equals experience, and before one can adjust one of these devices and determine requirements, the picture setting may have changed from what was at first desirable to record. A common fault with many pictures is that the camera was held with the long dimension of the plate vertical when it should have been horizontal.

One should not attempt to take photographs from moving trains, nor can good results be expected on a dark, hazy day, no matter how high grade the camera, unless due allowance is made for light conditions, and the exposure regulated accordingly.

Snapshots can never be so good as pictures made by resting the camera on a tripod, stopping down the lens properly and giving the correct time exposure.

Photographs were once inadmissible as evidence in court; now, however, it has become a common practice to so admit them. This suggests that proper record should be made of all attendant facts associated with a picture, especially the time and place of taking, and by whom made.

VALUE OF PHOTOGRAPHY TO ENGINEER

Photography can be made to serve the engineer in many ways that space does not permit discussing. Copies of tracings, contracts, records and similar papers often are desirable to complete a file, that could not be done if the only way were to place originals with correspondence or other papers on the same subject. For copying, however, the small camera will not serve, since the length of bellows does not in most cases permit reducing a plan to the full limit of the size of the plate.

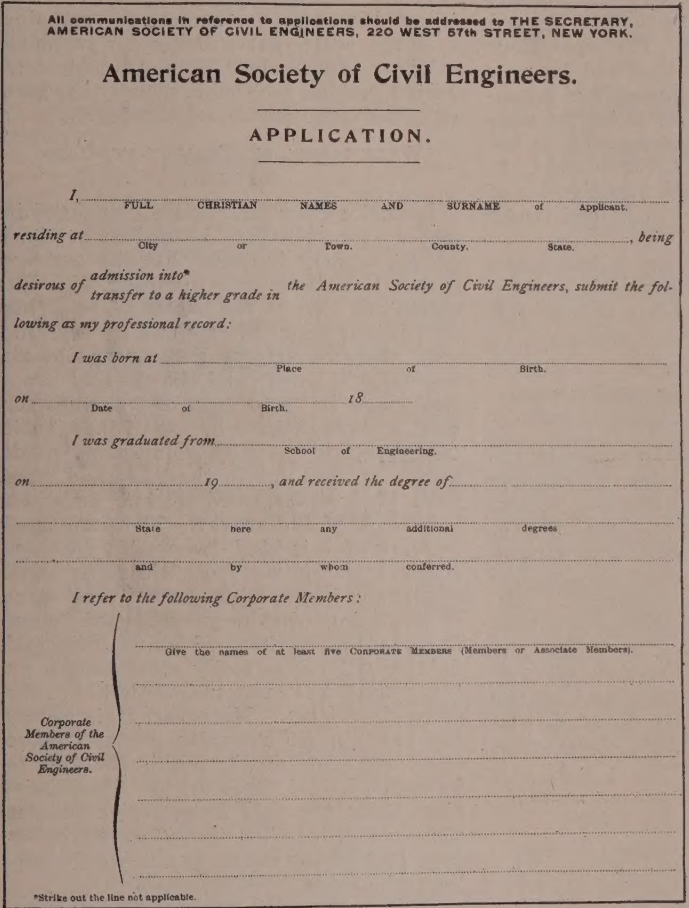
Pictures should not be made with the camera pointed directly toward the sun. The sun should either be at one's back or to the right or left a sufficient number of degrees so that its direct rays will not be focused by the lens, thus causing fog, or what is known as "halation," on the plate. Sometimes, of course, it is necessary to photograph an object with the camera pointed directly toward the position of the sun in the heavens. Then one should be careful to shield the lens from direct sun rays. If this is not possible wait until a cloudy day or take the picture earlier or later.

METHODS OF DEVELOPMENT

Only by learning how to develop negatives and to make prints can the camera user school himself as to correct exposures; and in learning to make negatives and prints he should not be misguided by every one who wants to suggest some private developing formula as one which will produce the most remarkable results—better than any recommended by the film or plate maker. It is safe to assume that the manufacturers of photographic apparatus and materials have expended a great deal of money in advancing the art-science of photography to its present notable position. There is never any better developing formula for a particular make of plate or film than the formula recommended by the manufacturer; and not until the person dabbling in photography has graduated from the dabbler's ranks and has learned from experience the chemistry of photography and the various processes which take place in fixing the photographic image on the plate or film, should he attempt to substitute solutions differing from those recommended by the plate or film manufacturer.

Detailed Information Required from Am. Soc. C. E. Candidates

CERTAIN changes in the form of application for admission to the American Society of Civil Engineers have recently been put into effect. The new forms are reproduced herewith. It will be noted that specific information concerning the time of each professional engagement is required and that each statement must be attested by "some one familiar with each engagement, preferably the person to whom applicant reported." It will be seen therefore that references from non-members are now admissible. It is still necessary, however, to refer to five corporate members of the society.



All communications in reference to applications should be addressed to THE SECRETARY, AMERICAN SOCIETY OF CIVIL ENGINEERS, 220 WEST 57th STREET, NEW YORK.

American Society of Civil Engineers.

APPLICATION.

I, ...
FULL CHRISTIAN NAMES AND SURNAME of Applicant.

residing at ...., *being*
City or Town. County. State.

desirous of *admission into** / *transfer to a higher grade in* *the American Society of Civil Engineers, submit the following as my professional record:*

I was born at ....
Place of Birth.

on .... *18*..........
Date of Birth.

I was graduated from ....
School of Engineering.

on .... *19*.........., *and received the degree of* ....

....
State here any additional degrees

....
and by whom conferred.

I refer to the following Corporate Members:

Corporate Members of the American Society of Civil Engineers.

....
Give the names of at least five CORPORATE MEMBERS (Members or Associate Members).

....

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*Strike out the line not applicable.

Miami Flood-Prevention Plans Sustained

Court Decision by Vote of Seven to Two Approves Program Proposed for Protection of Dayton District

BY A DECISION rendered Nov. 24 the flood-prevention plans of the Miami Conservancy District, which includes Dayton and Hamilton, Ohio, were sustained. Nine judges had been hearing the arguments on the plans, and the vote was seven for and two against. The judges were: Carroll Sprigg, Montgomery County; Otway J. Cosgrove, Hamilton; Willard J. Wright, Warren; Clarence Murphy, Butler; Frank Geiger, Clark; C. H. Kyle, Green; A. C. Risinger, Preble; Hugh Mathers, Shelby, and Walter D. Jones, Miami. Judges Mathers and Jones cast the dissenting votes.

The general scheme of flood prevention for the district was presented in the Engineering Record of March 28, 1914, page 356, while further details, dimensions and estimates of the completed plans were set forth in the issue of March 11, 1916, page 348.

The decision in full is as follows:

1. The court is of the opinion that the question raised as to the constitutionality of the law by reason of the decisions in the cases of Baumann vs. Dayton in the 66 O. S., and commissioners vs. Gates in the 83 O. S. is not now properly before the court for the reason that it does not appear that any assessment has been made against any specific piece of property and that therefore no one is now in a position to complain; and for the same reason other questions as to the unconstitutionality of the act on account of the method provided for the raising of funds is not now before the court.

To this finding Judge Mathers dissents.

2. The court is of the opinion that the Miami River is not a navigable stream in law or fact.

3. The court is of the opinion that any obstruction that may occur from the adoption of the plan to the public use or navigation of the Miami and Erie Canal is authorized by the contract between the conservancy board and the state officials as provided for in the conservancy act.

FULL PROTECTION

4. As to the objection that no construction shall be made under the authority of the act which will cause the flooding of any village or city unless the board shall have acquired and paid for the right to use the land affected for such purpose and shall have paid all damages incident thereto, the court is of the opinion that such provision of the law does not prevent the adoption of the official plan.

5. The court is of the opinion that channel improvement alone for the entire conservancy district is not feasible or practicable, and is prohibitive in cost and would not adequately protect the district from flood waters.

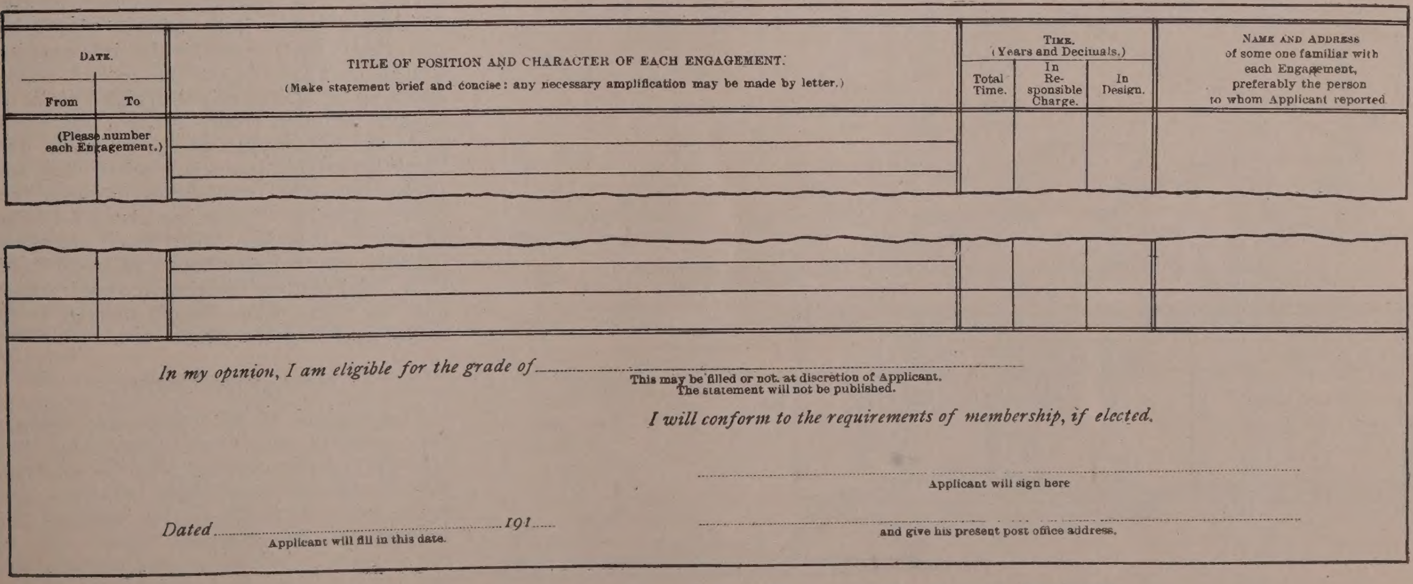
Judge Mathers dissents from the proposition that channel improvement alone would not adequately protect against floods.

6. The court is of the opinion that the combination of dams and dry detention basins, together with channel improvement, is the only practical and efficient method of protecting the Miami valley from the results of destructive floods.

EARTHEN DAMS

7. The court is of the opinion that earthen dams, with concrete conduits and spillways as provided for in the official plan, are safe and will be of sufficient strength to sustain at all times any burden that may be placed upon them by impounded water.

Judges Jones, Mathers and Kyle do not fully concur in the foregoing, but find that a preponderance of the evidence shows that



DATE.		TITLE OF POSITION AND CHARACTER OF EACH ENGAGEMENT. (Make statement brief and concise: any necessary amplification may be made by letter.)	TIME. (Years and Decimals.)			NAME AND ADDRESS of some one familiar with each Engagement, preferably the person to whom Applicant reported
From	To		Total Time.	In Responsible Charge.	In Design.	
(Please number each Engagement.)						

In my opinion, I am eligible for the grade of ....
This may be filled or not, at discretion of Applicant. The statement will not be published.

I will conform to the requirements of membership, if elected.

....
Applicant will sign here

Dated .... *191*..........
Applicant will fill in this date.

....
and give his present post office address.

NEW FORM OF MEMBERSHIP APPLICATION FOR AMERICAN SOCIETY OF CIVIL ENGINEERS the dams as provided will be reasonably safe.

8. The court is of the opinion that it would not be feasible to reduce the height of the Huffman dam or its spillway. To this Judges Kyle and Geiger dissent.

9. The court is of the opinion that the Lockington dam should not be eliminated from the official plan.

To this Judges Jones, Mathers and Geiger dissent.

10. The court is of the opinion that the objections filed to the official plan as proposed by the board of directors of the conservancy district should be overruled; that the work proposed in said plans is necessary and that the same will be conducive to and conserve the public health, safety, convenience and welfare of the Miami conservancy district, and the court therefore adopts the said official plan.

To the judgment of the court adopting the official plan, Judges Jones and Mathers dissent by reason of the finding made by the court in the ninth syllable hereof refusing to eliminate the Lockington dam; otherwise concurring with the majority of the court.

600-Foot Head Produces 2000 Horsepower

Guaso River Controlled as It Emerges from Cave—Head Operates Two Impulse Wheels and One Exciter Wheel

BY MEANS of a hydroelectric project now under construction in Cuba the power of the Guaso River is being developed from the source to a point about 2 miles away, where a 600-ft. head can be utilized to produce about 2000 hp. The Guaso River emerges from a mountain through the mouth of the cave, at which point a concrete dam and intake have been built. The minimum flow was estimated at 30 sec.-ft. during the dry season.

The sizes of pipe, profile of the line and location of the standpipe are shown in one of the drawings. Water is delivered to two Allis-Chalmers 560-hp. impulse wheels and a 60-hp. exciter wheel. These are direct-connected to 470-kva. 2300-volt three-phase 60-cycle Westinghouse alternators. Two 500-kw. step-up transformers of the oil-insulated, self-cooling type raise the voltage from 2300 to 23,000 for transmission. The power-house plans provide for the future installation of two more units. The switchboard was furnished by the General Electric Company.

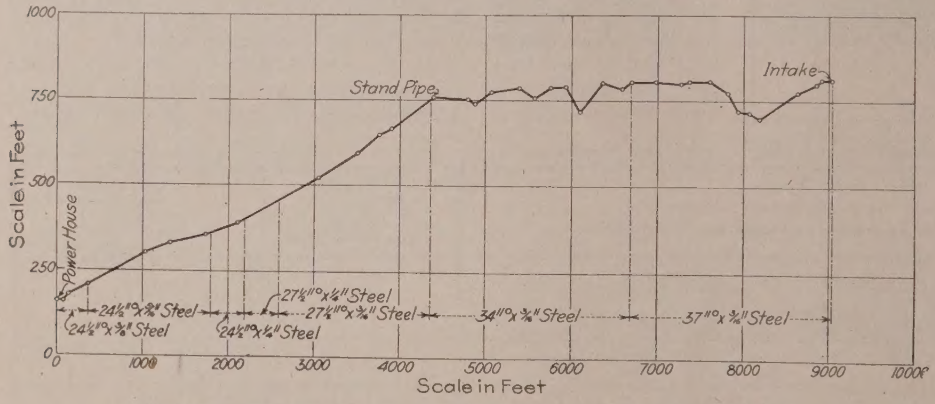
Current will be transmitted to the city of Guantanamo and there reduced to 2200 volts. The present power house of the former Guantanamo Electric Company will be used as a substation and its steam plant kept as a reserve.

The value of the location was discovered in 1900 by Eduardo J. Chibas and Arthur S. Hobby when they explored the upper part of the Guaso River during the first American intervention in Cuba. The concessions were granted soon after that and the new Guantanamo Electric Company was organized. The first plans and estimates were made by Mr. Chibas and approved by the government. Cary T. Hutchinson and C. F. Cook then made a thorough investigation of the project and presented their final report in June, 1915.

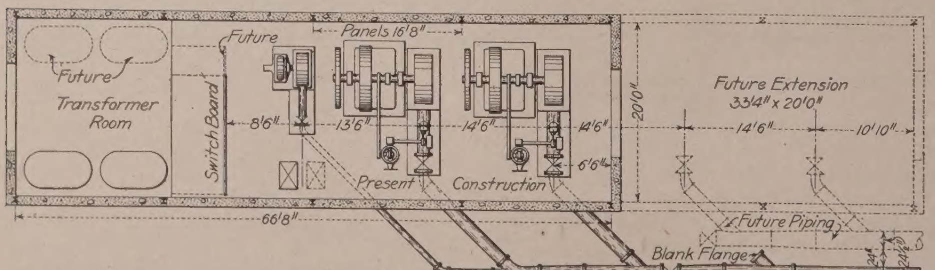
The work of construction is being executed by the Montreal Engineering Company, of which Carl G. Giles is president and A. E. French engineer in charge.

American Shipbuilding Approaches British in Volume

According to figures made public by the Department of Commerce, the shipbuilding industry in this country is reaching proportions comparable with those of the industry in the British Isles. On September 30 last, there were ordered and under construction in the shipyards of this country 417 steel vessels, aggregating 1,454,000 gross tons. There were at the same time under construction in the United Kingdom 469 vessels of the same class aggregating 1,789,000 gross tons. The Delaware River district exceeded by 13 vessels and 17,000 gross tons the New Castle district.



PROFILE INDICATES LOCATION OF STANDPIPE AND SIZES OF SECTIONS



PLAN OF POWER HOUSE, SHOWING EXTENSIONS FOR FUTURE DEVELOPMENT

Planetable Facilitates Making Station Maps

Success in Mapping Large Yard for Valuation Suggests Desirability of More General Use by Railroads

By R. E. DAVIS

Instructor in Civil Engineering, University of Illinois, Urbana, Ill.

AT PRESENT the valuation departments of many of the railroads of the United States are engaged in the field and office work incidental to the construction of the station and right-of-way maps and profiles required by the Interstate Commerce Commission. It seems appropriate to bring to the attention of engineers engaged in this work the possibilities of the planetable as an instrument for mapping to large scale, particularly for mapping extensive areas when there are many congested details, such as is usually the case with our large yards and terminals.

Weaknesses of Transit-and-Tape Methods

Inquiries from men actively engaged in making the resurveys in various sections of the country indicate that the average railroad engineer is acquainted with the planetable only to the extent of believing that it may economically and properly be used solely on intermediate or small-scale topographic work; and the general practice seems to be to make the surveys for station maps entirely by use of the transit and tape, the usually voluminous notes being "worked up" in the office and more than likely interpreted by one never on the scene of the survey. Those engaged in work of this kind (where all data are collected in the form of field notes) well realize the immense amount of time spent in gathering what may be termed "extra information," without which the principal data would be perfectly clear to one on the ground, but quite unintelligible to the office draftsman. Moreover, it is rarely the case on an extensive survey, where there are many details within the area to be mapped, that there are not vital omissions from the field notes which become apparent only after the office work has been started and the party making the survey has moved to other work.

During the past summer, on the resurvey of the northern division of the Chicago & Alton Railroad, the planetable has been used extensively in mapping complicated layouts, and an account of the mapping of the terminal freight yards at Glenn, 10 miles from Chicago, will illustrate the advantages of the method. The track layout at Glenn is 2 miles long and varies in width from a few hundred feet to half a mile. There are about 30 miles of track, together with yard offices, a roundhouse, transfer house, railroad Y. M. C. A., coal chutes, freight-car repair shops and the many other details usually to be found in a large terminal yard.

Horizontal Control

The method of procedure was first to run a series of closed transit and tape traverses, stations being established every 100 ft., the traverse lines being for the most part along the center lines of the ladders and the principal outer tracks of the various subdivisions of the yard, and the transit stations being placed at the P.I.'s. Approximately 8 miles of traverses with thirty transit stations furnished control for the entire yard.

The latitudes and departures of the traverse lines were then computed, each traverse adjusted to closure, the co-ordinates of the transit stations computed and the traverse lines plotted on 24 x 30-in. planetable sheets, the sheets being carefully cut with square corners and straight edges so that they might be butted together when plotting the traverses and also later when tracing the whole map.

It will be noted that up to this point field notes, except a record of the traverse angles and distances, have been unnecessary. It will also be seen that since 100-ft. stations have been established there are a large number of control points (the positions of which are shown on the planetable sheet) which may become planetable stations or may be conveniently utilized in establishing planetable stations in more convenient locations, or may be used as points of reference for direct linear measurements.

DETAILS

The method of constructing the detail of the sheets was as follows:

The planetable operator, with the planetable oriented at one of the control points or set up at some other convenient point and located by tape measurements from two control points, plotted the frog and switch points, and the P.C.'s and P.T.'s falling on the traverse lines, the distances from the control points being measured direct by two chainmen and the pluses being called out to the planetable operator. At the same time the plotting and chaining were checked by getting the direction to each point with a peep-sight alidade and the stadia distance with the telescopic alidade, the stadia rod being carried by the head chainman and being graduated to hundredths of a foot.

It was found with a rod graduated in this manner that for short distances (the distance from planetable to rod did not exceed 300 ft., and in general the maximum length of sight from each station did not exceed 200 ft.) the precision with which distances could be determined by stadia was consistent with the scale of the map (50 ft. to 1 in.). When getting direction to a point it is possible to manipulate the peep-sight alidade with much greater rapidity than the telescopic alidade, the latter being used only for getting the stadia distance, except on long shots.

Points on curves and on other tracks off the traverse lines were located by using the planetable as described, the plotted position of each point being checked, when convenient to do so, by scaling the distance to the nearest control point and comparing it with the corresponding actual distance as measured by the chainmen. Distances between parallel tracks were determined by direct measurement, the plotted position of the outer tracks being checked by direction and stadia distance as cited.

Buildings and other details of like character, as the work of plotting track progressed, were located by graphical triangulation from two or more planetable stations, or by direction and stadia distance if graphical triangulation was not practicable, and the plotted positions of buildings were checked by direct measurement of the sides.

It was found that the methods here outlined produced results, as far as the accuracy of the map was concerned, in every way the equal of results to be obtained by the more usual methods, the large number of control points and the manner in which the planetable was utilized making it possible to locate each point with respect to all other points as closely as the scale of the map would allow. Since the detail of the map was constructed in the field a much smaller number of observations was necessary than otherwise would have been the case, and there was no necessity for taking field notes. Since the map was made in the field the danger of omissions was reduced to a minimum, and the system of checking made serious mistakes, both in the observations and in the plotting, impossible.

Progress was rapid; an instrumentman and two rodmen ran the control traverses in three days, computed the latitudes, departures and co-ordinates and plotted the control on the planetable sheets in two days, and filled in the details of the entire map in six days. The office work was reduced to tracing the assembled planetable sheets.

Comparison of the time spent in the field with the time spent on similar surveys on which the more common methods have been used makes it seem not unlikely that the saving was 100 per cent, and with all survey data in the form of notes it is doubtful if a draftsman working alone could have plotted the map in pencil in less than ten days.

If this estimate is at all conservative it is quite obvious that the average railroad engineer cannot well afford to do without the planetable outfit as a part of his regular surveying equipment.

Difficult Problems Solved in Placing New Members and Larger Pins in Drawspan

Arthur Kill Drawbridge Near Elizabeth, N. J., Repaired by Special Methods—Bents on Fender Pier Fail to Support Loads as Planned

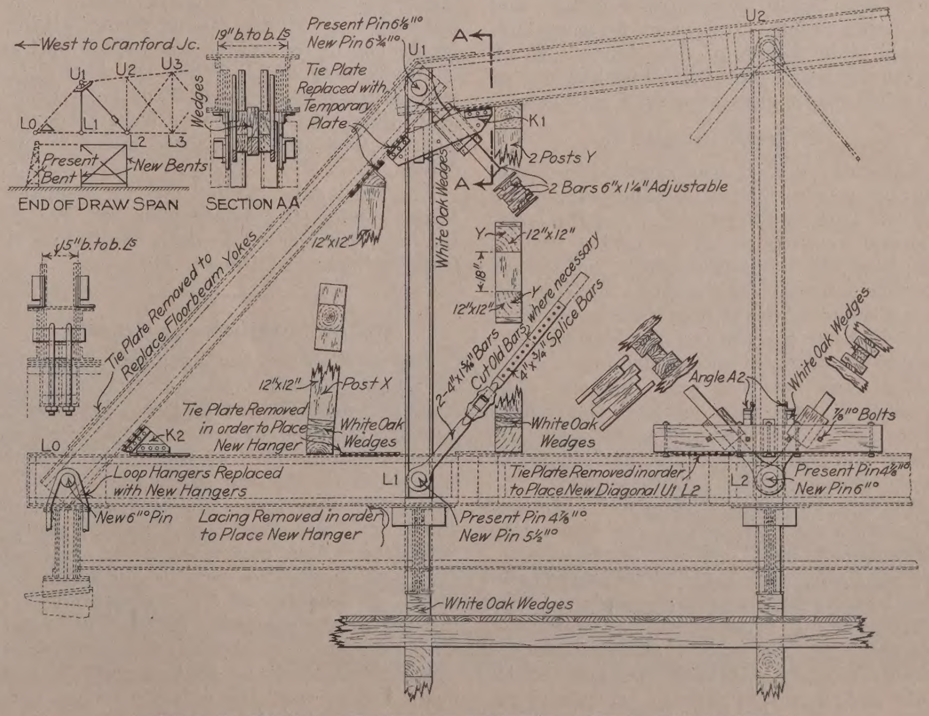
UNUSUAL difficulties encountered while replacing worn pins at the panel points near the ends of the long Arthur Kill swingspan of the Baltimore & Ohio Railroad, near Elizabeth, N. J., necessitated the adoption of an auxiliary adjustable diagonal attached to temporary brackets. This requirement arose from the fact that, in blocking up the panel points L_1 and L_2 from temporary timber bents placed under the span in its open position, it was found that instead of wedging the panel points up, the bents were forced down.

A well-planned schedule had been drawn up for reboring the pinholes at points L_0, U_1 and L_2, replacing the old pins by larger new pins, replacing the hanger U_1L_1 and the main diagonal U_1L_2 by new members, and splicing the diagonal L_1U_2 to make it adjustable. Temporary timber bents were built upon the old fender piers for wedging up the points L_1 and L_2. This schedule had to be revised with regard to points L_2 when it was found that the fender piers, constructed of timber cribs filled with soft material, settled under the temporary bents, so that it was necessary to supplement them by other means.

ADJUSTABLE RODS ADOPTED

This was accomplished by the use of temporary plate and angle brackets attached to the chords to carry pins to which four adjustable square rods were attached by means of stirrups and turnbuckles, as indicated in the sketch. This auxiliary diagonal was drawn up as found necessary to relieve the tendency to settle at the points L_1 and L_2. The pins used for this temporary work were old pins removed from other bridges and turned down to the required diameter.

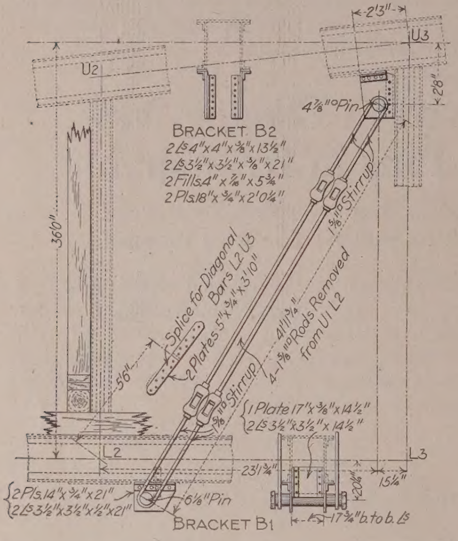
To replace a bar found to be bent in the diagonal L_2U_3, and to enable that member



DETAILS OF ORIGINAL METHOD FOR REPAIRING ARTHUR KILL DRAWSPAN to be adjusted to take its proper share of stress, a new end piece connected with splice bars was introduced.

Preliminary Work

Before any of the main repair work was started, the two temporary bents shown in one of the drawings were erected on the fender pier under the panel points L_1 and L_2 at each end, with the span in open position. All rivets in tie plates, lattice bars and portal struts which had to be removed to allow new members and pins to be placed were cut out between trains and replaced by bolts, the temporary tie plates and lug angles bolted on, and holes drilled for the splice bars to be attached to diagonal L_1U_2, in order to introduce the new adjusting turnbuckles and short connecting bars at the lower end, as shown.



AUXILIARY DIAGONAL USED WHEN BENT AT L_2 SETTLED

The necessary timber blocking and wedges were prepared, and the timber posts *X* and *Y* on each side of the hanger U_1L_1 placed and lashed securely, without driving the wedges. In the succeeding operations one end of one truss was completed before work was begun at the other points, and the panel points L_0, L_1 and L_2 were supported at both ends of both trusses, in all instances, when pins were knocked out or when old material was replaced with new.

Replacing Pins at L_0

The end pin at L_0 was replaced by blocking up points L_0 and L_1 and supporting the end post by the bracket K_2 at the lower end and by wedging up the timber post *X*, removing the tie plate above L_0 and the old floorbeam hanger and placing blocking between the members to hold them in position, removing the old pin and reboring the pinhole to 6 1-32 in. diameter, driving new pin and placing new floorbeam hanger. The brackets K_2 were then removed, the wedges under post *X* loosened and all tie plates replaced and bolted up before the bridge was swung closed and traffic resumed.

To insert the new members U_1L_1 and U_1L_2 the following sequence of operations was planned:

The panel points L_0, L_1 and L_2 were to be blocked up on the bents, the wedges under posts *X* and *Y* driven until the weights of the end post and top chord were released from pin U_1, brackets K_1 placed, the tie plate at L_1 removed and two horizontal 6 x 12-in. timbers placed over the lower chord to take the wedges under angles A_2, which were to be driven until the pin at L_2 was released from the weight of the post. The pins at U_1, L_1 and L_2 could then be removed and, after cutting out the necessary tie plates and lacing in the lower chord, the hanger U_1L_1, diagonal U_1L_2 and the lower ends of diagonal L_1U_2, after cutting old bars as shown, were to be removed and the new diagonal U_1L_2, the new hanger U_1L_1 and the bars with splice plates and turnbuckles in diagonal L_1U_2 placed in position.

The turnbuckles in the diagonals were then to be turned up, new pins of the old size driven at L_1 and L_2, and all members at U_1 blocked and clamped securely, the pinhole at U_1 rebored for the 6¾-in. pin and the new pin driven. The blocking and wedges could then be removed, the posts released, brackets K_1 removed, the tie plates and lacing replaced, the main diagonal adjusted and the bridge closed ready for traffic.

Procedure Revised

Owing to the fact that the wedges at the bents under joints L_1 and L_2 did not develop the required reactions because the timber bents and pier deflected, it was necessary to revise the foregoing procedure by adding the new temporary diagonal as described. The procedure was then as follows:

Posts *X* and *Y*, brackets K_1 and 6 x 12-in. timbers at L_2 were placed, and the panel points blocked up as originally planned. In addition, the timber posts adjusted by wedges were placed between the 6 x 12-in. blocks at L_2 and the top chord and temporary brackets B_1 and B_2 and the auxiliary rod diagonals shown in one of the drawings, using old rods U_1L_2, were erected. The end point L_0 was wedged up as much as possible to relieve diagonal L_2U_3 of load, and the auxiliary diagonal tightened. Thus the pinholes in the members at L_2 were brought to line and the work of replacing members and pins carried out as originally planned. The auxiliary diagonals and timber wedges were then loosened, the tie plates, lattice bars, etc., bolted on and traffic resumed.

In replacing the 4⅞-in. pin at L_2 with a new 6-in. pin, the members bearing on the pin were relieved of stress by again driving wedges under the timber posts, jacking up the end of the bridge and pulling up the auxiliary diagonals. When the bars L_2U_3 were relieved of stress and the holes properly lined, all members were securely clamped, the pinhole rebored and new pin driven.

The work was carried out by company forces under the supervision of W. S. Bouton, engineer of bridges, Baltimore & Ohio Railroad, Baltimore, Md.

Rainfall Statistics at Panama

The rainfall for the calendar year 1915 at Panama was above the average at 10 stations and deficient at 8 stations. The average precipitation over the Pacific section, as given in the report of Major-Gen. George W. Goethls for the year ended June 30, 1916, was 74.98 in.; over the central section, 102.61 in.; and over the Atlantic section, 148.60 in. The maximum 24-hr. rainfall recorded during the year was 8.30 in. at Gatun, on April 3 and 4. The rainfall during the first six months of 1916 has been above normal over the Pacific section and southern part of the central section, and below normal over the Atlantic section and northern part of the central section.

Relay Brick Pavement on Wet Concrete Cushion

Sunken Places Over Trenches and Sand Flows Obviated by Monolithic Construction, Reusing Seventeen-Year-Old Bricks

An experimental monolithic brick pavement has recently been laid in Champaign, Ill., on top of the existing base, reusing the original brick laid seventeen years ago. Prior to 1906 the brick pavements were practically all sand-filled, laid on a natural cement base over a 2-in. sand cushion. At the points where excavations were made before the laying of the pavement, most of the foundations have given away, leaving ruts in the roadway from 1 to 4 in. deep. Also, the sand cushion in many places has flowed to such an extent as to leave the surface rough. The original brick were of the repressed type and have spalled badly.

Two Pieces of Pavement Selected

Two pieces of pavement of about 150 sq. yd. each were selected. The first was a stretch where the brick were badly worn and the surface exceedingly rough. In the second the brick were not so badly worn, but the surface was rough and uneven. Both pavements were subject to heavy traffic.

The repair work was carried out as follows: Upon the cleaned original foundation was spread a 2-in. layer of concrete composed of 1 part cement, 3 parts sand and 2 parts roofing gravel. The brick, which had been thoroughly cleaned with wire brushes, were laid on the gravel foundation, inspected, rolled with a hand roller weighing 40 lb. per linear inch of bearing and grouted. The grout consisted of 1 part cement to 1 part sand. The sand was screened and the grout mixed and applied according to standard specifications. The street was then blocked for a period of fifteen days in order to allow the foundations to set properly.

Experience Gained

In commenting on the work as carried out, the city engineer makes the following statements: In the first or badly worn section the brick varied in thickness from 2½ to 4 in. As no effort was made to size them, it was very difficult to get a good, smooth surface. In this respect it is now believed a mistake was made. If the brick had been replaced in such a manner as to have the worn ones next to the curb and those not worn in the center of the street, a better and longer-lived surface would have been obtained. About 10 per cent of the old brick had to be replaced with new brick on the first section. On the other section where the original brick were in good condition, none of the above-mentioned difficulties were encountered.

All work was done by the street-repair gang, and as it was not very well equipped for this kind of work the cost, 80 cents per square yard, was considered high. Under the contract system, and with proper equipment, it is believed the cost can be reduced and still leave sufficient profit for the contractor.

The work was planned and carried out by F. C. Lohmann, city engineer, who states that these sections, opened the latter part of October, compare favorably in appearance with a new pavement, at one-fourth the cost to the taxpayer.

Develop Four Types of Bank Protection in Washington

Improved Design of Weighted Brush Mats Results on King and Pierce Counties River-Improvement Work

IN the intercounty improvement project which King and Pierce counties are jointly carrying out in the state of Washington, protection of the banks forms an important part of the work. Much of the natural river channel had to be relocated and some form of bank protection was required for the newly excavated slopes. The usual weighted brush mat construction was improved several times. A type was finally developed which is thought to embrace all the advantages of the several methods tried out. A general description of the project appeared in the Engineering Record of Nov. 11, 1916, page 587.

THIS WEIGHTED BRUSH MAT REVETMENT (TYPE 1) COST $5 PER FOOT

TYPE 3, COSTING $5.12 PER FOOT, HAS A FLEXIBLE MATTRESS AT TOE

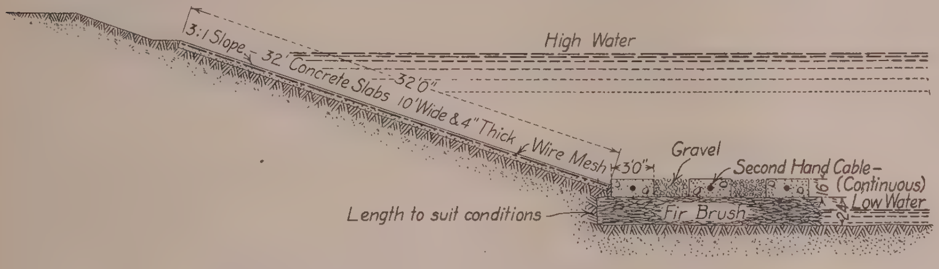
FIRST BRUSH MATTRESSES $5 PER FOOT

The first protection work undertaken consisted of four layers of brush mattresses, each 2 ft. thick, covering a 20-ft. strip along each bank. These were weighted with bags of concrete and river boulders. The construction in this case was of the same type as that used extensively elsewhere in the Northwest. An 1800-ft. stretch of this work near the Auburn dam, shown in one of the pictures, cost $9,000, or about $5 per linear foot.

CONCRETE BLOCK PROTECTION COSTS $5.82 PER FOOT

After this portion of the work was completed it was decided that a better method of placing the concrete on the brush would be to use removable wooden forms. By this system the weight of concrete used was increased at the same time that the cost per unit of weight was decreased. Additional strength and flexibility were added by stringing a cable through the forms before pouring the concrete. These concrete blocks, weighing 3600 lb. each, cover a 3 x 6-ft. area and are 16 in. deep. Of this construction, shown as type 2 in the illustrations, 1100 ft. was laid at a cost of $6,400, or $5.82 per foot.

Still another scheme of construction, known as type 3, was used for a distance of 837 ft. at a cost of $4,300, or about $5.12 per linear foot. This consisted of slabs 5 ft. square and 4 in. thick, containing triangular wire reinforcement and hinged together with ½-in. steel rods bent to interlock. The toe on the slope in this case was protected by four to six rows of reinforced-concrete blocks 2½ ft. square and 4 in. thick. These blocks were fastened together by ½-in. rods so as to form a flexible mattress.

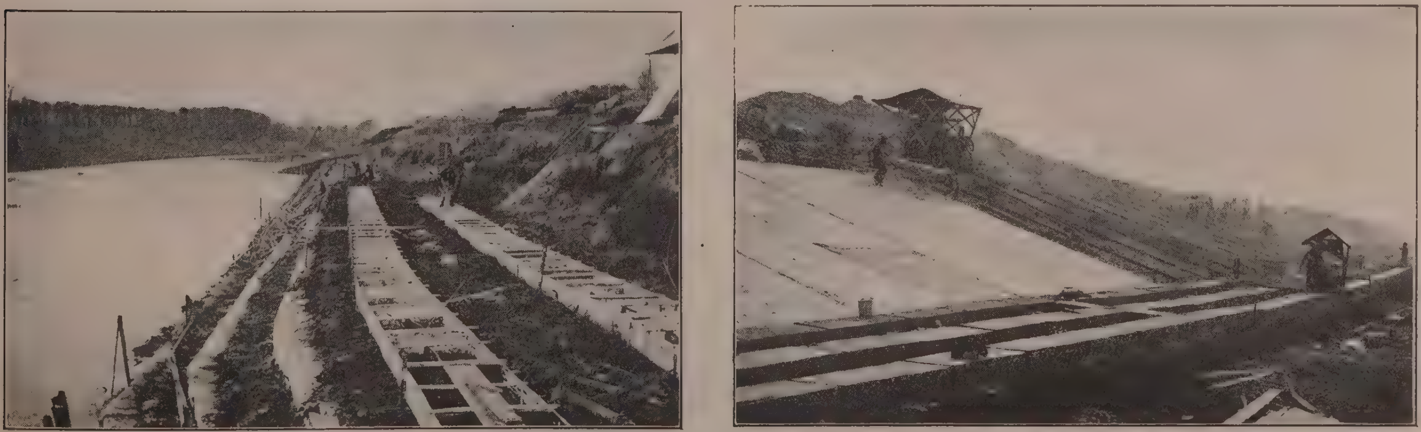

3:1 Slope - 32' Concrete Slabs 10' Wide & 4" Thick
32'0"
High Water
Wire Mesh
3'0"
Gravel
Second Hand Cable-(Continuous)
Low Water
Fir Brush
Length to suit conditions

DETAILS OF CHEAPEST AND BEST REVETMENT (TYPE 4)

A type preferred to all of the others consisted of a brush mattress 16 ft. wide and 18 to 24 in. thick, weighted with two or more rows of heavy concrete blocks, usually 3 ft. wide, 6 ft. long and 16 in. thick, cabled together as in type 2. From the toe of the slope to the high water line the banks, which have been graded on a 3:1 slope, were protected by a 4-in. reinforced slab 32 ft. wide. Of this type of construction 10,500 lin. ft. were placed at a cost of $51,130, or $4.86 per linear foot.

An analysis of cost on a 2631-ft. length of work, using type 4 construction, showed that by using 3.8 sacks of cement per cubic yard, and making a total of 1150 cu. yd., the total material cost in the weighted mattress section was $2,280. The corresponding labor cost was $2,300. For the concrete slab section, exclusive of slope grading, and using 4.2 sacks of cement per cubic yard, the material costs totaled $3,260, and the labor cost, while laying 1135 cu. yd., totaled $2,916. Under this arrangement 0.865 cu. yd. of concrete was used per linear foot of protected bank.

The intercounty river improvement project has been under the supervision of W. J. Roberts, chief engineer.



CONCRETE BLOCKS CONNECTED BY CABLES (TYPE 2, LEFT) COST $5.82 PER FOOT—RIGHT, TYPE 4 CONSTRUCTION, COST $4.86 PER FOOT

Annual Sand Catcher Costs at Columbus

Sewage from the East Side interceptor, a combined system in Columbus, Ohio, passes over a sand catcher with floors sloping to a narrow trough in which a motor-driven endless bucket conveyor travels. The conveyor is operated at frequent intervals before large accumulations are deposited. The power cost of operating the conveyor 2468 times in 1915 was only $2.30, according to the last annual report of C. B. Hoover, chemist in charge of the division of sewage disposal. There were 3837 wheelbarrow loads of sand and refuse removed. The power cost of raising and lowering the motor-driven vertical bar screens set in cages in tandem ahead of the pumps 1347 times was $3.50. The screenings amounted to 4122 wheelbarrow loads. The refuse from the sand catcher and the screens is spread over waste places near the station and does not produce a nuisance. The life of the small ⅜-in. bars in the rear screens after seven years' service has nearly been reached, as they are so badly rusted that some are broken and others badly bent out of position.

How Office Machinery for Spending a $1,500,000 County Road Bond Issue Works

Graphic Reports Posted in Chief's Office—Full Force Accounts and Early Checking of Extras Minimize Differences with Contractors

EXCEPT within the last few years, the expenditure of $1,500,000 in a period of two years on roads in a single county would have been considered a stupendous task for the organization having it in hand. Such a work is progressing smoothly in Vermilion County, and it is probable that all contracts will be completed on time Nov. 1, 1917. The way the superintending engineer and his force handle this amount of work to the apparent satisfaction of all concerned, from contractor to taxpayer, seemed, to a representative of the Engineering Record who recently studied the organization from top to bottom, almost more important than the details of construction.

PRELIMINARY WORK

When the present engineer took charge in 1915 the road routes had been selected and surveys made, but there remained the task of drawing up plans and profiles and calculating quantities on 166.15 miles of highway. A principal assistant engineer handled much of the detail of this work, assigning to it, as needed, engineers who would later fill the nine positions of division engineers as soon as the contracts were let. These men were not all taken on at once, but the work was laid out so that it was cumulative, and the eighth and ninth men were not put to work until the last week or so before the office work was complete. This method familiarized the future division engineers with their work, and for several weeks before the actual construction commenced the superintending engineer held a school of instruction in which not only specifications and methods of construction were discussed, but also tact in dealing with contractors and the people living along the roads.

The story of the methods by which 135 bids were obtained on the nine divisions and the service to the contractors in supplying all possible data as to transportation and availability of material has already been told (see Engineering Record, April 15, 1916, page 524).

GRAPHIC WEEKLY REPORTS

With each division engineer having about 20 miles of work, a graphic method of recording progress seemed the only way to make it comprehensible. Nine weekly charts on letter-size paper come to the chief and are posted on a bulletin board back of his desk for the following week. At a glance he can tell in what mile work is going on, for the division engineer plots in black the amounts previously reported and in red the current week's work. Two lines are used—the upper one to record miles and the lower one stations beyond the even quarter miles. At the end of the line is given, in figures, the total amount complete and the percentage of the whole. The following items are plotted: Excavation, subgrade, coarse aggregate placed, fine aggregate placed, pavement laid, macadam or gravel shoulders placed, road complete and road accepted.

Labor accounts are kept by the division engineers, and once a week a report on letter-size sheets is turned in to the main office, giving hours and amounts for each job, itemized by days for superintendence, excavation, shaping and rolling subgrade, hauling sand, stone, cement and brick, incidental hauling, hauling and placing tile and catchbasins, building side forms, mixing and placing concrete, handling joints, laying and rolling brick, grouting joints in brick, covering, seasoning and cleaning pavement, hauling and placing macadam or gravel shoulders, and finishing earth shoulders. The totals by days must equal the totals by items. This information is tabulated in the office to get at the final costs.

Of materials, the engineers report in detail on cement, sand, gravel or stone and brick, the cars and amount received and quantity used on miscellaneous materials, such as screenings, joint and shoulder material. For tile and lumber, totals only are given. Special reports on the cost and amount of labor and material are made on culverts as these are completed.

These four reports and the chart then give checks on the cost and progress of every job.

DAILY REPORTS ON POST CARDS

Daily reports are made on post cards. On cement, which the county furnishes, a full record is kept of amount on hand, received, used and remaining. Amounts used in each slab are recorded and the difference between this and amount required for the day's work is reported in amount and in per cent. These figures are tabulated on a single sheet in the office and form the basis of settlement at the time of each monthly payment. The county furnishes the cement and the contractor must pay for all over 2 per cent in excess of the required amount. If less than 2 per cent under the required amount is used, the work must be torn out. The daily check has kept the amounts used remarkably close to the cement required. On one contract 13,577.2 bbl. were used and 13,580.8 bbl. required. Differences are not allowed to be carried forward beyond each payment date. In fact all differences are adjusted each month with the contractor so that there is a minimum chance for controversy when the job is completed.

VERTICAL FILE CASE HOLDS 1200 BLUEPRINTS

Every day a post card with report of work done is sent in. This includes pavement laid, earth covered, canvas covered, watered in morning and afternoon, opened to traffic, quality of concrete work, coarse and fine aggregate, culvert work and position of grading gang.

HOW DISPUTES ARE AVOIDED

The division engineer settles any controversy he can, sending notice of it in triplicate to the chief for O. K. One copy goes to the contractor, one to the engineer and the third is filed. At the end of the construction of a section the division engineer resurveys the road in company with the contractor, so that all extras and deductions can be checked up at that time. A report and certification to this effect is then made to the chief with a request for final inspection. All additions and deductions from the work as originally contemplated are tabulated in the main office. They are all approved once a month by the county board, so that the engineer knows at all times his working balance.

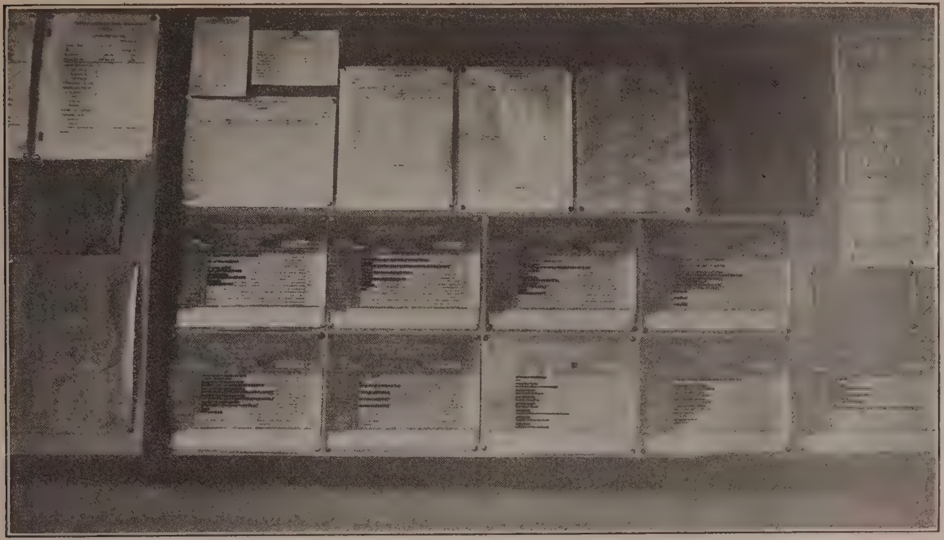
A brick inspector is located at the plant to cull as many as he can when the cars are being loaded. He selects ten bricks which he knows will go into the road and sends these to the office. A rattler outfit has been built in the basement of the county building on the clay floor. It is a double wall, soundproof room, 10 x 10 ft. in plan, with 1-in. flooring on the outside and beaver board on the inside walls and ceiling to retain the dust and noise. The machine rests on a 4-in. concrete floor which does not reach to within 3 in. of the side walls so as to eliminate any chance of carrying vibrations. The switches for both motor and lights are on the outside. To retain the dust, a special galvanized iron hood was made to cover the rattler, which is of the approved type. The 2-hp. Fairbanks-Morse motor furnished with the outfit, although subjected to the dust of the room, has shown no deterioration in a year's use. After a test has been completed the dust in the room settles sufficiently in one minute, so that the double doors, which have glass panels, may be opened. Without the hood it was necessary to wait ten minutes before entering the room.

The specifications call for a loss not to exceed 23 per cent and no individual brick to exceed 27 per cent. Ten bricks are tested at a time, and the average loss to date is 17½ per cent.

TESTING THE CEMENT

Cement is tested at the mill by a representative of the Pittsburgh Testing Laboratory, who sends the division engineer the results of the soundness test. Complete test sheets follow each carload. Usually the engineer gets the card about the same time the car arrives. For check purposes the division engineers send a sample of every tenth car to the laboratory at the county building.

Every car of sand and gravel is sampled on receipt. Tests are made in the field by the engineer, and a sample is also sent to the main office. For the field tests each division engineer has sets of sieves to test



WEEKLY PROGRESS CHARTS ARE EXHIBITED ON THE CHIEF'S BULLETIN BOARD FOR A WEEK

coarse and fine aggregate, scales and filter paper to test for clay and loam. The broken stone is inspected at the quarry. Samples for every car are examined before the car is allowed to leave the quarry yard. The result is immediately sent to the division engineer and once a week a detailed report on each is sent to the main office.

OFFICE HINTS

Plans and profiles of the roads under contract, although they number 1200, are all kept in a small vertical filing case, as shown in one of the photographs. The case is a simple wood frame made of 1 x 3-in. strips, 20 x 30 in. in plan and 4 ft. high. The drawings for each of the nine divisions are bound up with staples and secured by leather strips to hooks on 1 x 1-in. sticks resting on the frame.

The plans and profiles are kept separate from the cross-sections. The prints are about 3½ ft. long and 12 in. wide. There are about 100 blueprints required for each division.

The bulletin board mentioned previously is a 5 x 10-ft. piece of beaver board bound with ¼ x 2-in. wood strips. There are two of them in the chief's office. In addition to the progress charts there are exhibited maps of the roads, contractors' bids, blank forms of reports, any new ideas contractors are using to keep track of their own progress, recent photographs of the road, events and news items, and hints for the contractor in the way of new equipment or new ways of doing things. A political map shows the name of every one of the supervisors and township highway commissioners in the county, so that at a glance the chief knows with whom he has to deal in any township.

To get the work done on time is the ambition of the whole organization. Every legitimate means is used to spur on the contractors. Rivalry among them is called into play by a report each one receives every month, giving comparative figures of the divisions as to the amount done, rate, and rate at which work must proceed to finish on time. The accompanying table shows that the rate varies from 152 to 561 ft. per day, and that some of the contracts must proceed at a rate of more than 600 ft. per day during every one of the 156 remaining days.

CHIEF MAINTAINS CONSTANT CONTACT WITH WORK

Every week it is the custom of the chief to visit every one of the pieces of work going on in the county. Thus no long conferences are needed. Decisions are made on the job before they multiply. He averages 100 miles per day throughout the season. Incidentally his Ford has gone 13,000 miles this year and been in the shop but one-half day. His visits are pretty well timed, but not so those of the principal assistant, who gets out as much as the inside work will permit. The latter is the only other engineer in the main office. Primarily the work is being carried on in the field, only a clerk being in charge of the main office most of the time. Each division engineer drives his own car and is allowed $30 per month for upkeep and gasoline. The Vermilion County organization is headed by P. C. McArdle, superintending engineer. His assistant is C. A. Clark.

Ingenious Road Map Aids Travelers

South Carolina is one of the states that have marked the poles and signboards along the main roads by colored signs indicating the various routes of which the roads form parts. There are nine through routes crossing the state in every direction. To make it as easy as possible for the traveler to follow any of them, the state has issued a map in which the routes are indicated by the same colors that are used in the wayside marking.

RATE OF PROGRESS TABLE

Divisions	1	2	3	4	5	6	7	8	9
Actual number of days paving to Oct. 30	27	40	80	87	67	4	51	74	52
Linear feet of pavement laid	10,397	10,539	19,931	48,830	34,569	608	20,463	31,832	13,307
Average linear feet of pavement per day	385	263	249	561	516	152	401	430	256
Estimated number of working days remaining	156	156	156	156	156	156	156	156	156
Linear feet of pavement to be laid	94,800	95,131	75,285	20,709	63,290	89,100	7,463	72,427	88,510
Average linear feet pavement to lay per day	607	609	482	132	405	571	478	464	566

Favors Levees to Control Lower Colorado River

F. L. Sellew Presents Runoff Statistics and Discusses Probable Costs of Revetment Work to Protect Irrigated Lands

THE PROBLEM of where and how to control the flow of the Colorado River so as best to conserve irrigation interests with the least expenditure was discussed in a paper recently presented before the Southern California Association of Members of the American Society of Civil Engineers by F. L. Sellew. These notes have been taken from his paper. Mr. Sellew disagrees with the advocates of storage dams for flood control in the upper part of the Colorado system and believes that levees constitute the best and cheapest methods of protecting irrigated lands. He estimates that the entire expenditure for the protection of 200 miles would be only $12,000,000, as compared with $35,000,000 for controlling dams. The total area of irrigation importance, including 530,000 acres in Mexico, is 1,500,000 acres.

WHERE FLOOD PROTECTION IS JUSTIFIED

There are five areas along the lower Colorado, Mr. Sellew states, where flood protection by revetment is justified. These are Needles, Parker, Palo Verde, Yuma and Imperial Valley. The agricultural possibilities in the areas between these locations do not warrant the construction of levees, and here the river may be allowed to meander at will. The levees required at the five points mentioned range in length from 30 to 50 miles each, with a total length in the five districts of 200 miles. These levees should not exceed 8 ft. in height, he affirmed, and should be built with a crown width of 10 ft., with side slopes of 3:1, containing about 53,000 cu. yd. per mile.

The cost of the levee proper would be about $13,200 per mile, or $2,640,000 for the 200 miles; but it would be necessary to protect these levees with rock facings in order to insure their permanency. This rock work, allowing for the average 25-mile haul required in this district, would cost about $40,000 per mile, or $8,000,000 for the 200 miles. A sum of $1,500,000 should be added for a light track on the levee, which would bring the total levee cost for the 200 miles up to $12,000,000. This expenditure, he asserted, would develop a channel that would carry maximum floods without menace to adjacent interests.

To accomplish this same purpose by means of controlling dams would require storage capacity totaling 7,000,000 acre-feet, which he estimates would cost $35,000,000. So far as flood control is concerned, therefore, the levee method is indicated as the preferable plan. Assuming 1,000,000 acres of irrigable land depending upon the control of the stream, the total land value at $200 per acre would be $200,000,000; hence the cost of levee protection would be but 6 per cent of the value of the protected area.

FIVE AREAS OF IRRIGATION IMPORTANCE

The five areas of irrigation importance are as follows: Needles Valley, 60,000 acres; Parker, 200,000 acres; Palo Verde Valley, 100,000 acres; Yuma, 160,000 acres; Imperial Valley, 450,000 acres—total, 970,000 acres. Adding to this area, which is in the United States, the irrigable areas in lower California would swell the total to about 1,500,000 acres.

Assuming the annual duty of water at the diversion point as 5½ acre-feet per acre, the maximum storage for continuous irrigation would have been necessary during the low flow of 1902-03. In that season a storage capacity of 2,400,000 acre-feet would have provided for the entire 1,500,000 acres. Assuming the cost of an acre-foot of storage at $5, $12,000,000 would provide for the 1,500,000 acres, and adding to this the $12,000,000 required for levee work, a total of $24,000,000 would furnish both protection and a sufficient minimum flow. Taking the 1,500,000-acre total, this cost would be at the rate of $16 per acre.

Storage of Upper Waters Not Feasible

Referring to Water-Supply Paper 393, by E. C. LaRue, Mr. Sellew "heartily disagrees" with the idea that sites can be developed on the upper Colorado River system behind which could be stored a total of 30,000,000 acre-feet. Reviewing the available data regarding the sites at Marble Cañon, Bluff on the San Juan, Junction of the Green and the Grand River, and Kremmling on the Grand River, Mr. Sellew submits reasons why the possibilities in each case are not promising. In most cases the doubt rests on the improbability of suitable foundations, but in the case of the Kremmling site "in order to use it Congress would have to reverse a former chief executive who decided that Gore Cañon was more useful for a railroad than it was for a dam."

The three sites that may be counted upon, Mr. Sellew states, are in Green River, as follows: Flaming Gorge, 2,000,000 acre-feet; Juniper Mountain, 1,400,000; Minnie Maud, 4,000,000 (perhaps), or a total of 7,400,000 acre-feet, which is all that he believes has been proved feasible at the present time. This would be further reduced by the fact that the runoff of the Green River will justify the creation of only 6,000,000 acre-feet of storage. From these facts he concludes that "in the light of present knowledge the Colorado River cannot be controlled by reservoirs, however desirable such a result may be."

Grade Crossing Is Eliminated by Special Construction Methods to Maintain Traffic

River Road Concrete Bridge Near Hoboken on 36-Degree Skew Erected in Two Parts, Using Construction Girder and Temporary Columns

Limited right-of-way space and the necessity for maintaining the double-track traffic at the grade-crossing elimination on the Main Line, Boonton Branch, of the Delaware, Lackawanna & Western Railroad at Delawanna, 10 miles west of Hoboken, N. J., where River Road is being depressed under a reinforced-concrete bridge wide enough for five tracks, required the design of a special construction girder and temporary columns. After diverting traffic as far as possible to the south, the excavation and construction of the north half were completed. The traffic was then diverted to the permanent tracks on this portion after the concrete had set for 28 days, and the remainder of the bridge is now being completed. The construction girder carries the skew corner loading on the first part while the second part is being completed, and then becomes a part of the finished bridge not essential for the strength of the slab, since the reinforcement of the latter is continuous through the girder. The temporary columns were poured simultaneously with the half arch of the pier up to the construction joint to insure support of the construction girder until the arch is completed, after which the columns are removed.

Abutment Walls Vertical Slabs

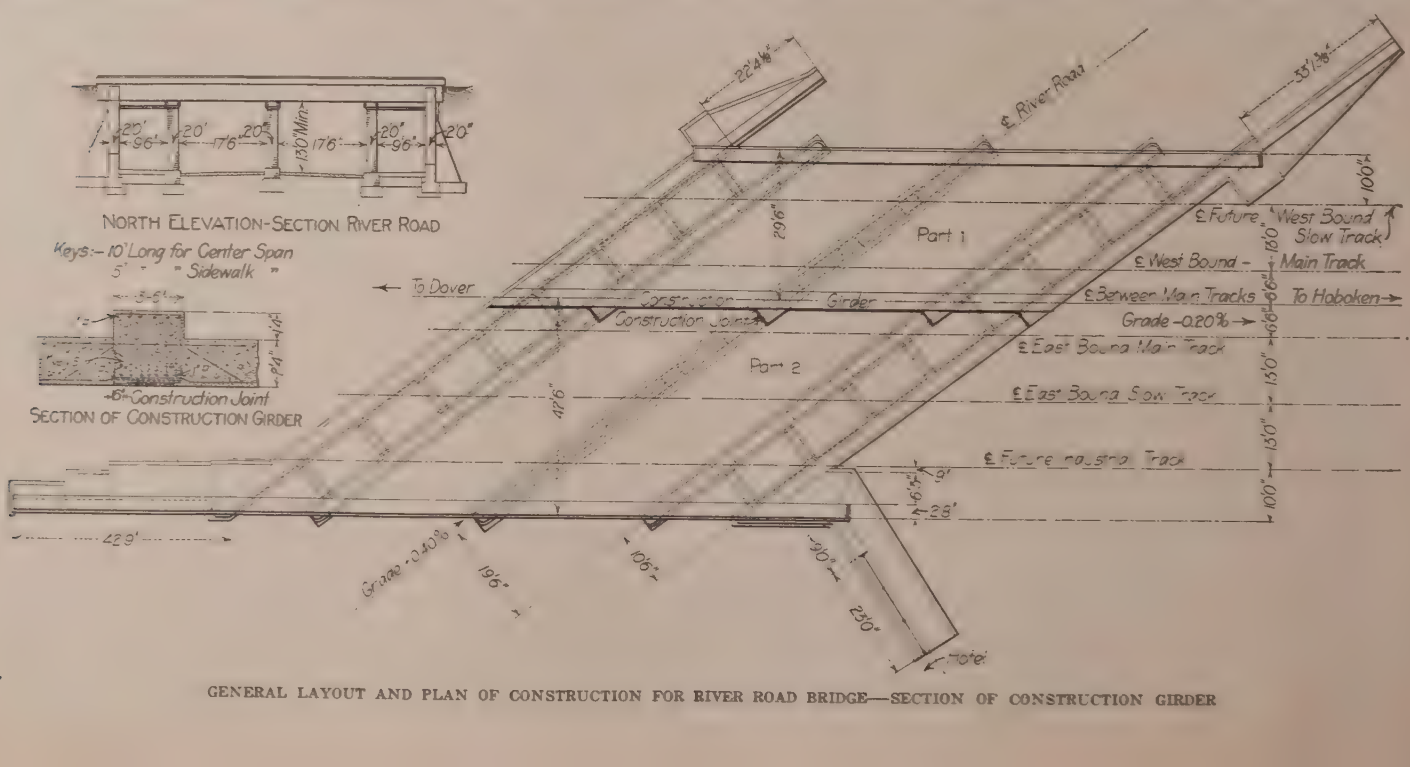
Economy in the amount of concrete needed for the structure was obtained in the design of the long abutment walls as vertical slabs, with struts to the adjacent piers, and of the intermediate piers as beams and columns, with curved openings to improve the appearance from the street. The parapet walls are designed as girders to carry the skew corner loading to the piers and abutments, the reinforcement in the heavy slab being laid perpendicular to the latter.

As indicated by the plan and elevations, three existing tracks and two future tracks are carried over the depressed River Road at an angle of skew of 36 deg. and about 13 ft. minimum vertical clearance. The concrete slab varies in thickness from 28 in. to 18 in., and is reinforced by ¾-in. and 1-in. square bars laid perpendicular to the supporting piers and abutments. In order to save concrete and improve the appearance, the intermediate piers are designed as columns and beams, with openings having elliptical curves at the top. The abutments are designed as vertical slabs between the roadway slab at the top and a horizontal beam at the bottom. Struts top and bottom are provided at the columns about 14 ft. apart to transfer the pressure to the adjacent piers.

Skew Requires Construction Girder

Traffic on the two main tracks was maintained by the use of two temporary tracks laid on the company's right-of-way as far to the south as possible, without encroaching on hotel property immediately adjacent. These tracks still interfered with the construction of the bridge, so that it was found necessary to build the structure in two parts. Part 1 on the north side was carried up to a construction joint just beyond the center line between the main tracks, as shown, so that it cleared the sloped embankment supporting the temporary tracks.

As the steel in the slab is placed perpendicularly between the piers and made continuous over them, it was necessary to support the loading on the skew corners of Part 1, after the tracks had been shifted to this part and until the south part could be constructed and the projecting rods concreted into the slab. This was accomplished by the use of a construction girder formed by increasing the slab depth 18 in. on the upper side for a width of 3 ft. 6 in. on the center lines, as noted, and adding the tem-



GENERAL LAYOUT AND PLAN OF CONSTRUCTION FOR RIVER ROAD BRIDGE—SECTION OF CONSTRUCTION GIRDER

SLAB REINFORCEMENT—CONSTRUCTION GIRDER IN BACKGROUND

SLAB AND CONSTRUCTION GIRDER POURED IN ONE OPERATION

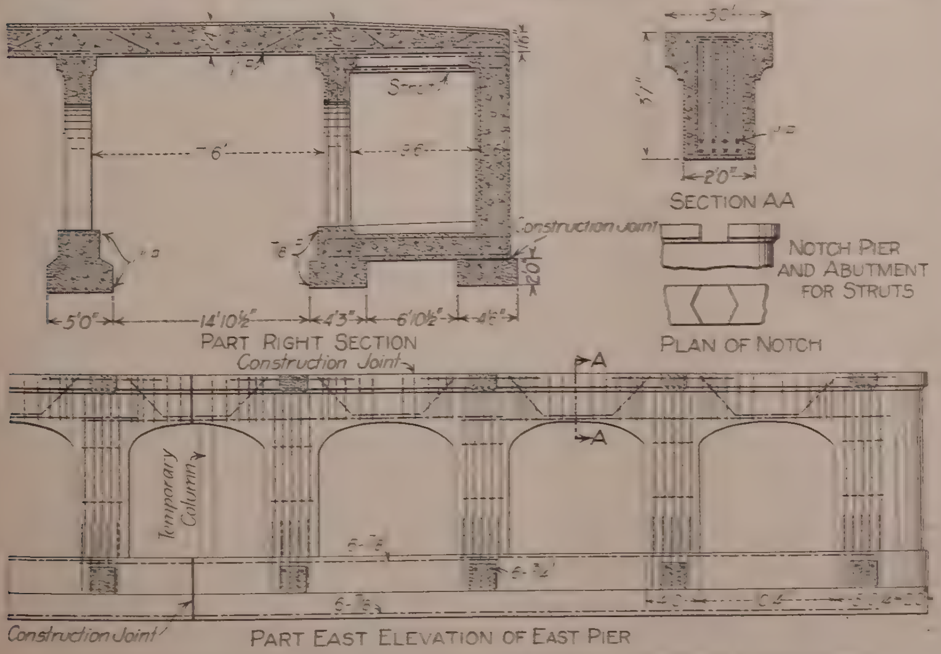
porary columns already mentioned. The outside skew corner loading is carried to the parapet walls, which are designed as beams to carry the loads to the piers and abutments. The concrete in the slabs, in the construction girder and the parapet girders was cast in one operation.

DESIGN LOADING

The bridge is designed for a standard engine loading about equivalent to Cooper's E-60 on each track, assumed to be uniformly distributed over a width of 13 ft. laterally. Placing wheels in position for maximum bending moment in the long skew span, an equivalent uniform load per square foot was obtained. This was used as the loading on the short span between piers and abutments in designing the slab, beams and columns. An impact stress of $L^2/(L+D)$ was included, L being live-load stress and D dead-load stress. Dead load included 12 in. of ballast under the ties.

When completed, the maximum grade of River Road will be 5 per cent for 214 ft. at the north side of the crossing. Two clear roadways 17 ft. 6 in. wide and clear sidewalks 9 ft. 6 in. wide will be furnished, and thus afford ample trafficway for this important thoroughfare.

The bridge was designed under the supervision of G. J. Ray, chief engineer of the Delaware, Lackawanna & Western Railroad Company, under the direction of A. B. Cohen, concrete engineer, and constructed under the supervision of G. T. Hand, division engineer, with G. B. Barackman as assistant engineer in charge. James A. Hart of New York City is the contractor.



PART RIGHT SECTION THROUGH BRIDGE AND LONGITUDINAL ELEVATION OF EAST PIER

Corrosion Develops at Panama Lock Gates and Valves

General Goethals, in Annual Report, Discusses Extent of Damage and Methods of Repair

In the maintenance of the locks of the Panama Canal the protective paints on the gates and electrolytic action in the valves and their various parts developed unexpected difficulties this year, according to the annual report for the year ended June 30, 1916, of Major-Gen. George W. Goethals, governor of the Panama Canal. The report, which was made public this week, gives the following information regarding the condition of the gates and valves:

LOCK GATES RECOATED

At the time the locks were watered all the gates had been painted and put in first-class condition. The interiors of the gates were coated with Bitumastic enamel under a five-year guarantee, and the exteriors were covered with various kinds of submarine paints. When the floating caisson arrived in December, 1914, it was installed at the lower east lock at Miraflores and the chamber pumped out, permitting an examination of the gates, valves, and fixed irons. At that time they were found to be in good condition, although there was some rusting of the plates and rivets. In January, 1915, the west chamber at Miraflores was pumped out after being submerged about 15 months. The paint on the gates was blistering badly, and from experience gained from various paints applied at other lock gates it was decided that something must be adopted that would give better protection than anything in the paint line that had yet been used.

Difficulty had been experienced with paints applied to the spillway gates at Gatun, and because of the condition of the interior of the gates on which Bitumastic enamel had been used it was decided to test out the use of this material on one of the spillway gates. It appeared to give adequate protection, and as the contractor guaranteed the effectiveness of this material for five years a contract was entered into for coating all of the lock gates with Bitumastic enamel. The gates at Gatun were coated and the work finished. Due to the condition of the pumps in the caisson, the impeller blades of cast iron being entirely eaten away, work on the Pacific side was not completed.

VALVES CORRODED

Observations during the past year disclosed that the corrosive action on the cylindrical valves has been severe. In July, 1915, the west flight of Gatun locks was drained, and all the accessible cylindrical valves were examined. Marked corrosion was taking place on certain parts of the valves, although the entire valve was made of cast iron or steel, no bronze parts being adopted in the original design. In the lower level an average of 75 per cent of the seal segment nuts were corroded; in some cases fully half the nut had disappeared. It was also found that the bolts holding the stops in place were in such condition that they had to be replaced in every valve in the lower level. All valves were put in good condition and painted with red lead. On the Pacific locks no examination was made of the valves at Pedro Miguel or those on the west side of the Miraflores center wall, but the east valves at this site were found to be in good condition. However, as all painted surfaces of the valves had failed, it was decided to coat all exposed iron and steel surfaces with enamel, and a contract was entered into for doing this work.

Considerable corrosion has taken place in the rising stem valves. The ½-in. plates have been attacked in a manner similar to those on the lock gates, and portions in the vicinity of the rivets in the lower valves at Gatun and the upper and lower valves at Miraflores have been violently attacked. The bottom seal casting of the valve which comes in contact with the babbitt-metal seal on the bottom of the valve is being rapidly eaten away. A number of the valves at the Pacific locks were in such condition that the bottom seal had to be machined off to make the valve tight. In order to protect the valve from any further electrolytic action between the cast-steel seal and the lower babbitt-metal seal, all babbitt metal was removed and replaced with a seal of greenheart lumber. Some of the bronze side seals and springs were found to be broken both at Miraflores and Gatun. Otherwise the seals were in good condition, and required only a small amount of draw filing to make the contact surfaces perfect. The top gate-valve seal is of cast steel, and is held in place by bronze bolts. In practically every instance the corrosion has been excessive around the heads of the bronze bolts, cutting away the metal, and in some cases allowing the bolts to loosen and fall out. Several castings had to be replaced. The worst case of corrosion of the seal occurred on the upper valves at Miraflores.

Lignum Vitæ for Seals

At Gatun, practically all valves were installed with fixed side seal castings, which all gave evidence of considerable corrosion, but not sufficient to cause any leaks. At Miraflores, removable side-seal strips were of machinery steel, and in every case corrosion had reached such a point that all side seals had to be replaced. Inasmuch as the corrosion had apparently been aided by the proximity of the bronze side seals which bear upon them, it was decided to replace all machinery steel with lignum-vitæ wood, in this way tending to place an insulating substance in contact with the bronze. All porous concrete around the fixed irons was removed and replaced with cement, and wherever babbitt metal had been used to fill the recessed holes for bolt heads at the Pacific locks the metal was removed and replaced with cement.

At both the Atlantic and Pacific locks considerable corrosion of roller trains has occurred, the rollers of which are made of tool steel. At the Atlantic locks a number of rollers, bolts and filler castings were missing. All were replaced, and the heads of all bolts were riveted over to prevent further losses. Similar conditions were found at the Pacific locks, and as it is impossible to protect the rollers by any paint, arrangements were made to install ½-in. pipe from the tunnel floors down to the base of the roller-train tracks. Crude oil is forced through the pipes, and it is believed from the results of experiments made with a model that the crude oil will rise along the surface of the roller-train track and in this way protect the rollers by coating them with oil.

As a result of the examination of the valves at Gatun it was decided to have them coated with Bitumastic enamel. At the Pacific locks more complete protective measures were taken, as follows: (1) All bronze side seals were lined up and strips of zinc bolted to the valve, each side of the seals, at the bottom of the valve; (2) where necessary, the bottom valve seal was machined off to give solid metal contact with the bottom seal; (3) all removable side seal strips were taken out and replaced with lignum-vitæ wood strips. Where removable strips were not installed, the fixed irons were milled down to take the wooden side seals; (4) all babbitt metal used in the assembly of the valve for embedding and protecting boltheads from corrosion, and for calking purposes, was removed and replaced with cement; (5) all babbitt metal used in the bottom seal was removed and replaced with greenheart lumber; (6) all steelwork of the valve was coated with Bitumastic enamel. This left only the bronze side seals exposed; (7) all fixed irons were coated with Bitumastic enamel; (8) the channel-iron supports for the rollers were coated with Bitumastic enamel, and arrangements made to lubricate the roller trains and tracks with crude oil during operation and while the valves are submerged; (9) all submerged portions of the valve stems were coated with Bitumastic enamel; (10) all bronze bolts are being replaced with steel as fast as breakage occurs.

Bronze Bolts Fail

On Oct. 10, 1915, the counterweight of spillway gate 13 at Gatun gave way and dropped into its pit, demolishing all weights. This machine had not been operated for several days, and was not being operated at the time of the accident. On investigation it was found that all four manganese bronze counterweight bolts had given way. Each spillway counterweight consists of 56 cast-iron blocks weighing 750 lb. each, resting on a cast-iron base plate and supported by four 1¾-in. manganese bronze bolts running into a cast-steel yoke at the top. The total weight of the counterweight is 45,700 lb., and, assuming that the load is equally distributed, each bolt supports 11,425 lb., or a stress of 4750 lb. per square inch of metal. Sections of the bolts were sent to the mechanical division for test, which gave an ultimate tensile strength of 61,400 lb. and 63,900 lb. per square inch respectively for the two bolts tested. This would indicate a factor of safety of about 13.

All guard-valve counterweight bolts were examined, and instructions given to replace the defective ones with steel bolts. An examination of the Miraflores spillway counterweight bolts resulted in finding two bolts broken off at the head and others with surface cracks, indicating probable failure. All counterweight bolts of the spillway gate machines have been replaced with steel, and bronze bolts are being replaced with steel wherever failures occur.

Stock Rolls Stones on Road

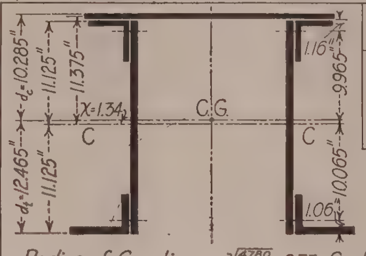
Removal of rocks rolled onto the road by stock feeding along the sidehill above the road and dragging are the principal duties of a caretaker maintaining the 12-mile Mongollon-Hill section of the Prescott-Flagstaff highway in Arizona.

To Compute Properties of Unsymmetrical Sections

Tabular Form Simplifies Determination of Radius of Gyration or Section Modulus of Column Section by Slide-Rule Method

BASED upon the well-known relation between moment of inertia I_g about an axis through the centroid or center of gravity of a given area A and the moment of inertia I_c about any other parallel axis x in. from the centroid, the tabular form of computation here given is found to simplify the computation of required properties for unsymmetrical column sections. Bridge chords, for example, are designed for both direct and bending stresses—the radius of gyration is necessary in order to obtain the allowable unit stress and the section modulus for the compression side is required in computing the bending stress.

In the fundamental formula $I_c = I_g + Ax^2$, the value of I_c about some convenient axis, preferably the center line of the web plates, is first computed, and the eccentricity x, or distance from the center of gravity to this axis, is found by area moments of the unsymmetrical parts, as indicated in the table; that is, the resultant moment is divided by the area A. The desired moment of inertia I_g about an axis through the center of gravity is then easily computed by the equation $I_g = I_c - Ax^2$. This explains the procedure in the table. The value of the section moduli, I_g/d_c for compression or I_g/d_t for tension are then obtained, if desired.



Section	Area □"	Lever Arm "	Moment M	Multiplier for Area	I_c-Axis CC
1 Cov. Pl. 26x½	13.00	11.375	148	11.375^2	1680
2 ∟s 4x4x7/16	6.62	9.965	66	9.965^2	660-2∟s 10
2 Web Pls. 22x11/16	30.25	—	214	$22^2/12$	1220
2 ∟s 6x4x11/16	12.80	10.065	130	10.065^2	1300-2∟s 20
	A=62.67		84		30 30

$M \div A = X = 1.34$

$I_c = 4890$

$AX^2 = 110$

$I_g = 4780$

Radius of Gyration $= r = \sqrt{\frac{4780}{62.67}} = 8.73$ Section Modulus: Compression $\frac{I_g}{d_c} = \frac{4780}{10.285} = 465$; Tension $\frac{I_g}{d_t} = \frac{4780}{12.465} = 384$

COMPUTATION FOR RADIUS OF GYRATION AND SECTION MODULUS OF UNSYMMETRICAL SECTION

The values of I_c for moment of inertia, given in the last column, require some explanation. For the cover plate, flange plates and angles, the areas are multiplied by the square of the distance from the axis CC. This is the significant term in the equation $I_c = I_g + Ax^2$. The I_g for the horizontal plates is negligible and the nearest round figure for the I_g of the angles has been used. In most cases, even this value for the angles is a small percentage of the other figures, and will not affect ordinary slide-rule work. Of course the I for the vertical webs is found from $bd^3/12$ or $Ad^2/12$.

Although for approximate preliminary computation, rough ratios of the depth can be used for radii of gyration, r, the final design requires exact values for these quantities. Hence any decrease in the time of computation is a vital factor. The advantages in the form presented herewith are in the elimination of the usual work in computing new lever arms after the position of the center of gravity is determined, and in the combination of the simplest method for finding the center of gravity with the computation for I_c in simultaneous operations, followed by a simple operation to obtain I_g, the desired moment of inertia.

British Government Fosters Application of Scientific Research to Industrial Problems

Advisory Council Reports Activity of Past Year in Methodical Investigation to Insure Effective Co-operation for Trade Expansion

REPORTING the activities of the first year of its work, and discussing in full detail in a 56-page pamphlet the plans and needs for future success, the advisory council of the British Committee for Scientific and Industrial Research is developing principles about which engineers in this country should be informed. In view of the efforts being made in the United States through the work of the Naval Consulting Board and the National Research Board (the latter discussed editorially on page 639 of last week's issue), the following abstract of the first annual report has direct application to the problems which will face us when the war is over.

OBJECT AND APPROPRIATIONS

The advisory council to the committee of the Privy Council for Scientific and Industrial Research, reporting to the British Parliament, was created July 28, 1915, "for (1) instituting specific researches; (2) establishing or developing special institutions or departments of existing institutions for the scientific study of problems affecting particular industries and trades; and (3) the establishment and award of research studentships and fellowships." Its chairman is Sir William S. McCormick.

In the first annual report of the committee, recently issued, it is stated that twenty scientific investigations of industrial importance have been approved and grants made to a number of individual research workers, not exceeding £6,000 (about $30,000) for the first year. The amount appropriated for the initiation of the scheme was £25,000, and for the current year £40,000 was voted.

SCOPE OF REPORT OF ADVISORY COUNCIL

The first annual report of the advisory council discusses previous government action relating to the advancement of trade and industry by means of scientific research, the present government scheme, the details of the methods used, parallel movements, trade associations, impediments to industrial research, the need for a new outlook, American and German practice, the sphere of universities and technical schools and of special research institutes, research and government departments, and, finally, research and the empire.

The scope of the present work is further indicated by the statement that the government intends to deal with this problem as an integral part of a comprehensive improvement in the educational system.

NECESSITY FOR CENTRAL CONTROL

It is pointed out that while the necessity for central control of the machinery for war has been obvious for centuries, not until this war revealed the essential unity of the knowledge required for both the military and industrial efforts of a country was this vital fact understood. The instruments of war are now forged by the man of science. "This is equally true of the weapons of industry. The brains, even the very processes, that to-day are necessary to the output of munitions were yesterday needed, and will be needed again to-morrow, for the arts of peace. This is the central fact which justifies the establishment of the new machinery in the midst of a struggle that is absorbing the whole energies of the nation in a way no previous war has done."

WHY PURE SCIENCE MUST BE NEGLECTED

In view of the average manufacturer's requirement of quick returns, and as a present basis for a considered program and policy, the council decided to give applied science precedence over pure science. The universities, which are the natural homes of research in pure science, have been so depleted of both students and teachers by the war that they are barely able to continue routine work and cannot command either the leisure or the detachment which is an essential condition of original research. Inquiries show that "any effective encouragement of research in pure science must await the return of peace."

To save certain researches being conducted by professional associations which were in danger of enforced abandonment, the council recommended the payment of a series of grants to the societies concerned. Many interviews have been had not alone with the principal engineering society representatives but with others from professional and manufacturers' associations. It is noted that the most highly organized industries are those which have made the most use of scientific research—especially the engineering trades, backed by distinguished professional societies.

SURVEY OF RESEARCHES

A careful survey is being made of "the amount and the character of the provision made in our higher educational institutions for research work," as a part of the preparatory arrangements for a systematic program of aid to individual researchers. It is hoped, also, to induce industrial firms to inform the council, in confidence, of the problems they have in hand or in contemplation. "It is obvious that even this modest degree of co-ordination will be abortive unless the principal manufacturers are willing to trust the discretion of the council."

There are found indications or a change in view among certain firms, resulting from the necessities of the war, leading to interchange of information, which may survive the present critical days. "In the numerous conferences we have had with representatives of different industries we have been impressed with the spirit of co-operation which is growing up and the willingness to accept our suggestions for the initiation of research for the benefit of the trade as a whole. Co-operative research, when it has done its utmost, will always leave ample room for individual initiative and ability in the application of its results, more than sufficient as an incentive and as a means to outstanding success. Co-operation is not the negation of individual effort; it raises initiative to a higher power."

In spite of the grave effects of the war on the field of research in educational institutions, the council has recommended grants to some forty individuals. It is stated that "research in pure science should be as much our care as research in applied science; it is the necessary precedent of all industrial applications, and the universities are peculiarly fitted to pursue it, though for the reasons already explained it is not possible to do much in this direction during the war." The council hopes to bring more reality into academic laboratories now dominated by the textbook and the syllabus of examination, and "so encourage a better professional training for chemists, physicists and other men of science."

DANGER IN APPLIED RESEARCHES

On the other hand, the report says: "At the same time we recognize that there is a danger in bringing technical problems too pressingly to the notice of teachers and students in educational institutions. We must not tempt those capable of making advances in natural knowledge to abandon their austere studies for the sake of solving temporary and local technical problems. Still less must students be encouraged to take up such questions except as stimulating incidents in their general training. On the other hand, pure science has in the past owed much to observations, suggestions and difficulties which have come from activities external to the laboratory or study. So it will be again; and it is our desire so to order the relations of workers in pure science to the industries going on around them that they may receive the stimulus of a wider outlook than is always attainable under the limitations of an academic system of syllabus and examination. In this way it may be possible in the end to create such an atmosphere that the new generation of students will cease to draw a distinction between 'theory' and 'practice,' and technologists of all ranks will through them attain to the view that sound practice is only theory tempered by compromise."

Applications for aid were received from the professional societies, and this led to the formation of a group of standing committees to assist in surveying the whole field of research and dealing with such applications. Three standing committees have been set up—a committee on metallurgy, a committee on engineering under Sir Maurice Fitzmaurice as chairman, and a committee on mining. Each committee consists of about fifteen members, of whom approximately one-half have been nominated by the professional society concerned.

BEST ADVICE SOUGHT

"The council hope with the assistance of their standing committees, the professional societies, the Home Office and the Board of Trade gradually to construct panels of names which will enable them to obtain the very best advice on the different aspects of the problems they are called upon to solve. The advice they need may be commercial, economic, financial, or scientific. The best opinion in all these spheres will, it is hoped, be available on the panels for the guidance of the council and their standing committees, and will insure the confidence of the industries concerned that the steps proposed have been considered in all their aspects."

Discussing the need for a new outlook, the council says: "If a healthy condition of inquiry is to be fostered in the scientific industries, they must for some time to come expend a good deal of attention and money upon convincing the manufacturing world in general that scientific research is a paying proposition. They believe that the shortest means to this end is an attack upon the pressing problems of manufacture which arise in the course of the ordinary routine—problems which the manufacturers ought, no doubt, to solve by means of their own scientific staffs, but which their present staffs are too small to undertake, often because the firms are too small to bear the necessary cost. It was in this way that the universities of the middle states of America convinced the farmers that science was useful to agriculture."

Reference is made to the work of the Mellon Institute, of Pittsburgh, and to support given by certain trades to research at Yale University, and also to special grants made by the German government to single firms in certain unusual cases.

CONDITIONS OF SUCCESS

In conclusion, the report refers to a full list of the researches aided up to the present, given in an appendix. The probable insufficiency of trained research workers after the war is emphasized, and further, the need not so much for outstanding minds of exceptional power, but for systematized work of more ordinary investigators under competent direction. "There is as much place and need for plodding labor in scientific research as in other kinds of work." Greater progress in co-operative effort is given as the second condition of success, and the report says: "If the general level of manufacture can be rapidly raised by co-operative effort in the exchange of information between firms, and in the support of national trade institutes for research, as well as in the improvement of the conditions and efficiency of labor, this country will have gone far toward establishing its industrial prosperity on a firm basis."

Tidal Lock with Special Safety Devices for Large Dock at Chemulpo, Korea

Japanese Government Is Making Important Improvements in Harbor Works—Great Range in Tide Makes Unusual Precautions Necessary

By HENRY GOLDMARK

Consulting Engineer, New York City; Recently Designing Engineer, Panama Canal

A HUGE DOCK, 700 x 1500 ft. inside dimensions, provided with storage sheds and railroad connections, is being constructed by the Japanese government in the harbor of Chemulpo, Korea. Owing to the extreme range of tides at this port, the tidal locks and gates at the ocean end were designed with special safety devices to prevent danger to shipping and to the miter gates. Among the principal features here presented are the valve frames and operating mechanism, the gate operating machinery and the electrical equipment.

GENERAL FEATURES

In pursuance of its policy of industrial development in Korea, the Japanese government is making some important improvements in the harbor of Chemulpo, the principal port of the country. The facilities for the transfer of freight have been very meager, as the great range of the tide and the absence of suitable docks have made it necessary to load and unload all large vessels by lighters.

The works now under construction consist of an inclosed basin, the Jinsen dock, in which vessels will be moored, and a tidal lock connecting the dock with the outer harbor. It is also proposed to improve the channel leading from the lock entrance to deep water. The dock, which is about 700 ft. wide and 1500 ft. long, is to be provided with storage sheds and railroad connections. A minimum depth of 27.5 ft. will be maintained at all times. When the tide falls below this normal dock level the gates will be closed and vessels locked in and out. At higher stages of the tide all the gates will be wide open and ships will pass freely from the outer harbor to the mooring basin.

DETAILS OF LOCK

The lock is shown in plan and elevation in one of the drawings. It has a clear width of 60 ft., a length of 424 ft. between the gates and a depth of 48 ft., giving a freeboard of 4 ft. above the high water of ordinary spring tides. The walls are of mass concrete, faced with granite at the gate quoins and sills and other important points, and there are heavy floors, from 10 to 15 ft. thick, reinforced with steel rails.

The filling system consists of a longitudinal culvert 6 ft. wide and 7½ ft. high in each side wall, with six horizontal 3 x 4-ft. outlets, the bottoms of which are 7 ft. above the lock floor. The culverts for emptying the lock are of the same size as the filling culverts, and discharge through outlets in the lower gate recesses. There are six valves in all, which are in the main culverts, four used in daily operation, the other two, at the ocean end, being utilized only when the lock is to be pumped out.

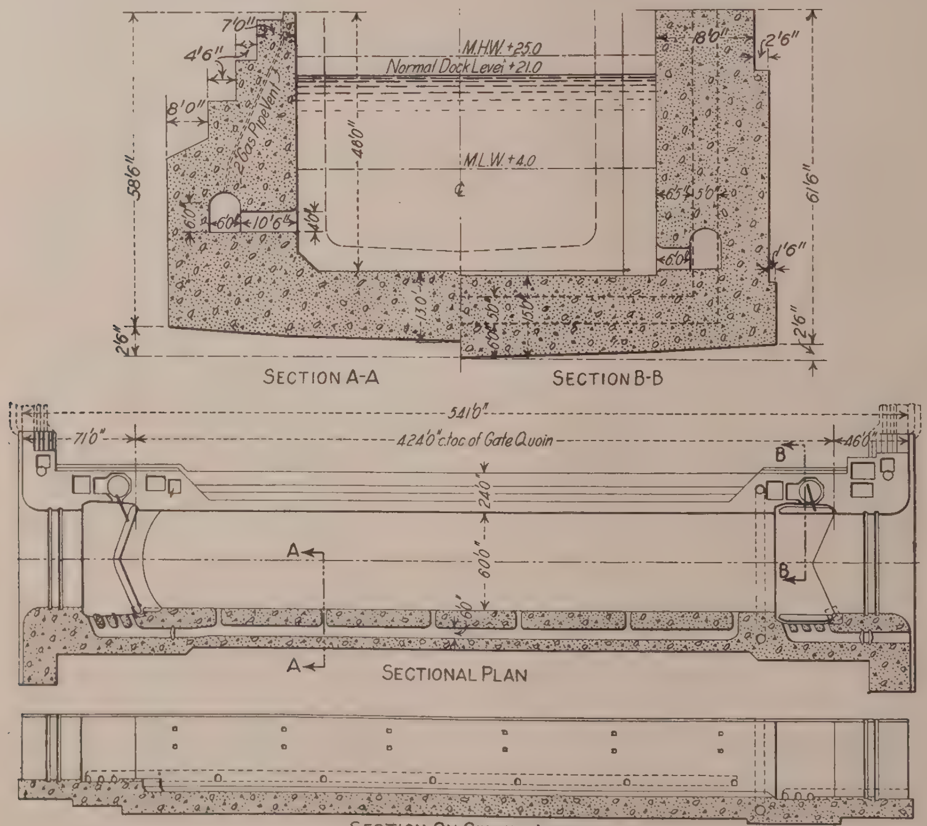
The steel lock gates are of the mitering type with air chambers, and, like the valves, are operated by electric motors. Four capstans, also driven by electricity, will be installed to assist in the handling of vessels.

DETAILS OF VALVES

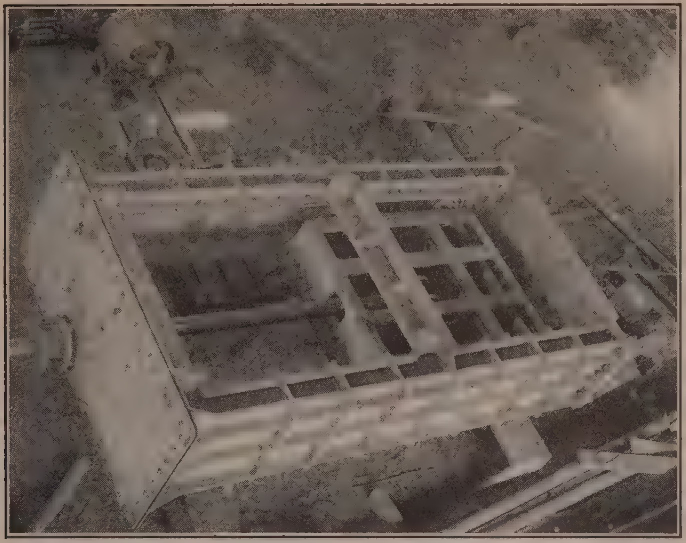
The general plan of the valves at the upper end of the lock and the machinery for raising and lowering them is given in one of the drawings. The double valves at the lower end have a common operating mechanism with a single motor. One of the valves with its frame is seen in one of the photographs taken at the shops, where they were all assembled to guard against errors in fitting. It will be noticed that they are of the type known as "wagon-body" valves, which roll on four large wheels secured to the main casting. This form has been used extensively on Canadian canals and also in the United States, and was adopted for the large drydock at Panama just completed.

For openings of moderate size, wagon-body valves are simpler and cheaper than Stoney valves with loose trains of small rollers, and move quite as freely. They have generally been built of structural steel, though cast iron was preferred for the Jinsen dock in order to reduce the corrosion in salt water. Careful workmanship is necessary to insure an equal distribution of the hydrostatic load over the wheels, and their chilled treads should be accurately ground to size.

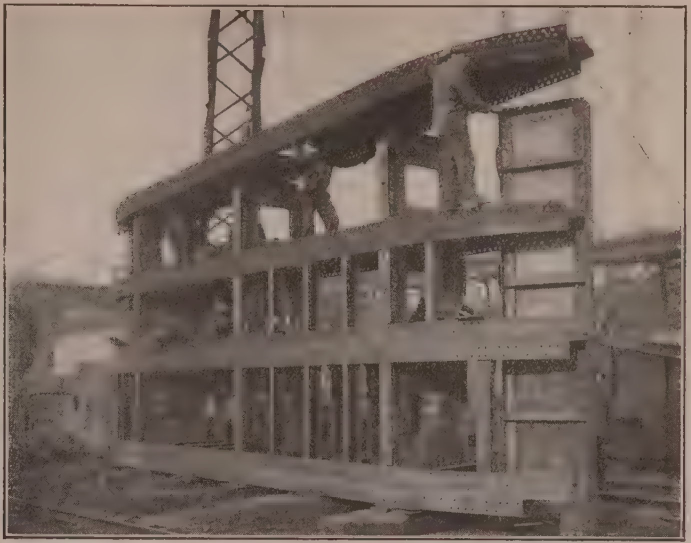
The design adopted for the fixed frames in the walls was the result of careful study and is believed to have special merits. Much trouble has been experienced with large valves in setting the frames correctly in the concrete, especially when the side-



SECTIONS OF LOCK BETWEEN DOCK AND OCEAN—NOTE CULVERTS AND OUTLETS



VALVE AND FRAME ASSEMBLED IN SHOP BEFORE SHIPMENT TO SITE



ASSEMBLING THE SECTIONS OF LOCK GATE IN CONTRACTOR'S YARD

castings are not rigidly connected. In many cases the main frame does not extend above the culvert opening, and small guide rails are used for the upper part of the gate travel, which it is almost impossible to set accurately. In some large locks recently built the great care required in placing the fixed frames interfered seriously with rapid and economical concreting. Nevertheless, it was afterward necessary to go to heavy expense in correcting errors in setting.

ADVANTAGES OF THESE FRAMES

The frames here adopted are made long enough to guide the valves through their whole stroke, and have heavy cross-pieces at the top and bottom. These maintain the correct distance between the side pieces and permit the entire frame to be handled as a unit. Even if it should be slightly out of plumb, the valve would work properly, as the stem has a flexible connection at the top. All the frames were assembled in the shop to guard against errors. The joint between the valve and frame is made tight at the sides and top by rubber seals and at the bottom by a strip of babbitt metal on which the valve rests.

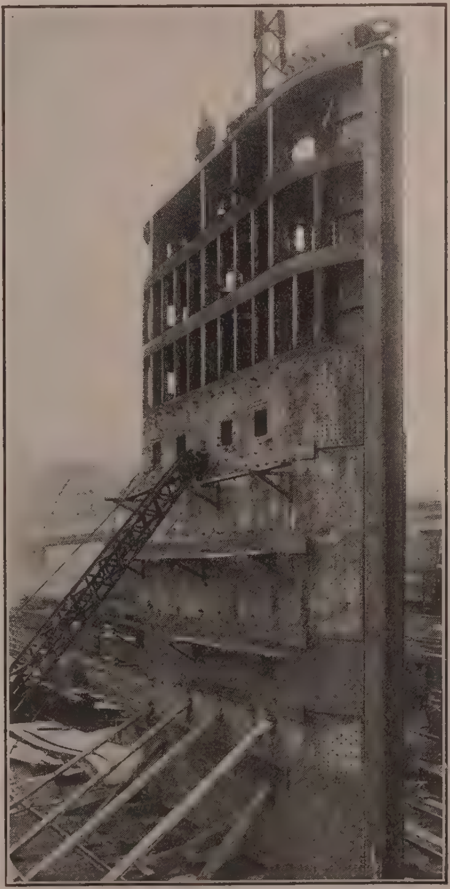
The valve is raised and lowered by a stem made of 6-in. double extra-heavy pipe, which is fastened to a pin at the bottom and screwed at the top into a crosshead nut of phosphor bronze. The latter is moved up and down by a revolving screw and comes to rest against springs at the top and bottom. It is guided by steel bars riveted to a suspended structural frame. There is a roller thrust bearing to resist the downward force, while the small upward reaction is taken by a shoulder in the casting. The screw is driven from the motor shaft by a gear-and-pinion reduction and two bevel gears. The small gears, motors and other electrical equipment are in a separate machinery room, the horizontal shaft passing through a stuffing box in the dividing wall so as to exclude water from the machinery.

LOCK GATES

The lock gates are of the mitering type, with air and water chambers. Single-skin gates without flotation chambers have many advantages, even for fairly large locks, as all parts are more accessible for inspection, repainting and repair, while they are also lighter and less expensive. Plans for both types were submitted to the harbor authorities. They preferred the double-skin gate.

The gate leaves are horizontally framed, with girders 4 ft. deep, spaced about 5 ft. apart, so that the interior compartments are comparatively easy of access. Their shape is the same as that used at Panama and in the latest lock at Sault Ste. Marie, the lower face being straight throughout, the upper curved near the ends. Curved leaves, forming a circular arch from quoin to quoin, are still advocated by some engineers, but very seldom built, as a slight saving in weight is more than balanced by the greater cost of the shopwork. Straight leaves have also practical advantages, especially in avoiding deep recesses in the masonry.

The upper gates are 39 ft. and the lower 47 ft. high, the length of the leaf being 33 ft. and the rise of the sill equal to one-fifth of the lock width. There are three sets of vertical frames extending from the top to the bottom and channel intercostals, for stiffening the skin, at intervals of about 2 ft. At the quoin and miter posts heavy vertical-plate diaphragms distribute the end thrust.



LOCK GATE LEAF NEARLY ASSEMBLED

The gates rest on hemispherical pintles of nickel steel 14 in. in diameter, with carbon-steel pin caps, and turn at the top on 10-in. nickel-steel pins with phosphor-bronze bushings. The quoin and miter posts and the clapping sill attached to the gate are of greenheart timber, and the hollow quoins and fixed sills of polished granite. The air chamber in the lower part of the gate, which is not subdivided, is accessible at all times by a manshaft with ladders extending to the top; and there is also a manhole near the bottom. The upper part of the gate forms a water chamber. The entire weight is hung from the anchorage, as no rollers on the lock floor are used. There are two riveted anchor frames, triangular in shape, one at right angles to the lock wall, the other approximately parallel to it, which extend about 14 ft. into the concrete. The upper and lower gate leaves weigh 290,000 lb. and 240,000 lb. respectively. One of the larger leaves was completely assembled at the contractor's yard. Two photographs herewith show stages of the erection. The gates will be erected in the field by Japanese contractors.

GATE-OPERATING MACHINERY

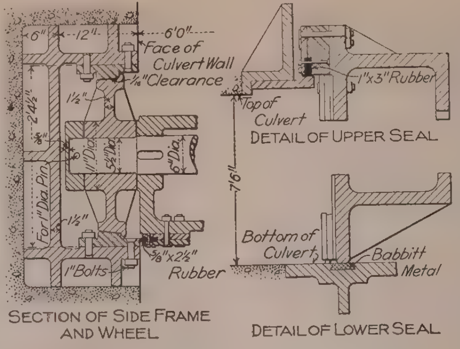
The mechanism for opening and closing the gates is of the bullwheel type devised by E. Schildhauer for the Panama Canal. The motor and the smaller gears are again placed in a watertight machinery room. Some interesting tests made in the Panama locks since their completion have shown that, under the conditions prevailing there, the resistance to the movement of the gates is greater when they are close to the sill than in any other part of their travel.

In the plans here adopted a slight change in the position of the bullwheel center was made, by which the speed of the gate when almost fully closed, and hence the maximum motor load, has been greatly reduced. A similar reduction in the resistance to the gate at the other end of its stroke was obtained by deepening the recesses in the walls.

The three-phase alternating current at 60 cycles and 220 volts is furnished by a central power house, which also serves other installations. All the sluice and lock gate motors are normally operated from a small central-control house at the middle of the lock wall, but each motor can also be controlled from a switchboard in its own machinery room. The main control switchboard is on the second floor of the control house, from which all parts of the lock are visible to the operator. All power and control cables are cambric-insulated and lead-sheathed, and drawn through iron conduits embedded in the concrete close to the top of the lock wall.

The motors are started and stopped by contactor panels in the several machinery rooms. There are two double-pole contactors for each motor, one for opening and the other for closing the gate, which carry the main current. The motors are ordinarily started by the operator in the control house, and stopped by a limit switch connected to the motor shaft when the gate or valve has reached the end of its travel. Indicators are installed both in the individual machinery rooms and the control house. There is a set of three lights for each machine. Red and blue lights indicate the open and closed positions respectively; the white lights show when a valve or gate is in motion.

All the motors for the gate and valve operation are interchangeable, being standard 22-hp. motors with a synchronous speed of 720 r.p.m. They are of the squirrel-cage form, designed for intermittent service, entirely inclosed and fitted with solenoid brakes mounted on extensions of the motor shaft. As a safety provision against overloading the sluice-valve motors, there are mechanical friction cutoff couplings attached to the motor shafts. In the case of the lock gates, overload on the motor and excessive strains in the gate and machinery, due to accidental obstructions, are guarded against by an auxiliary cut-out switch fastened to the strut, which stops the motor when the compression of the springs in the strut exceeds proper limits.



DETAILS OF SIDE FRAME AND SEALS

SPECIAL SAFETY DEVICES REQUIRED BY TIDAL CONDITIONS

The great range of the tides at Chemulpo and the character of the gate-operating machinery introduce some special dangers, which are absent in most other locks. The dangers in question are of two kinds:

The first would occur in case of failure to close the gates when the tide dropped to normal dock level. The depth of water would soon be insufficient to float vessels and serious damage might easily result. A neglect of this kind is not unlikely to occur, especially at night, when there may be only a single attendant on duty.

To meet this danger, it is proposed to install a simple telltale device. It consists of a float switch placed in a well in the dock wall, which will ring a signal bell when the water drops below any desired level. Connections are made with the operating circuits, so that the bell will continue to ring until the attendant has closed the proper switches and all the upper lock gates and valves have actually started to close. It was not thought safe to have the lock gates close automatically, as there would be some risk of collision with a passing vessel.

DANGER FROM HIGH TIDES

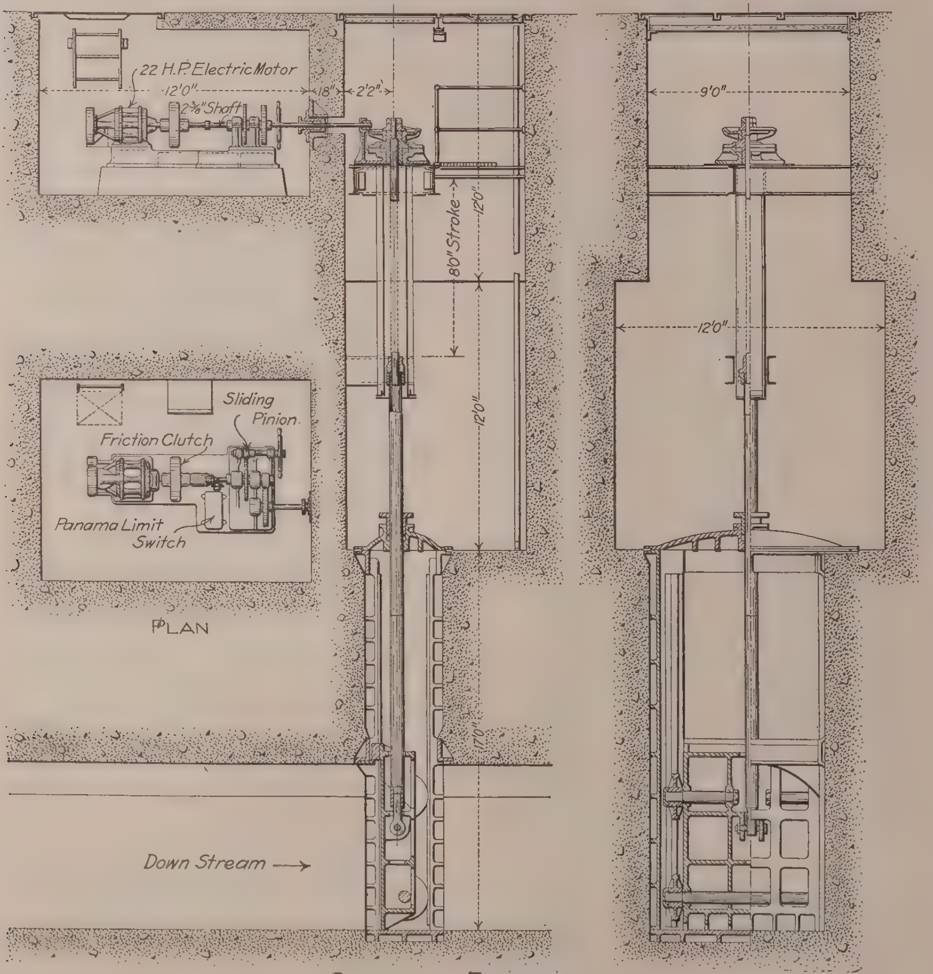
The second danger to be guarded against would arise from neglect to open a lock gate when the tide rose higher than the water level on the upper side of the gate. Where miter gates are operated by chains it is customary to leave the latter loose after the gates have been closed, so that a pressure on the downstream face merely opens the leaves. With the type of machinery in the Jinsen dock the strut holds the gates very rigidly and a reverse water pressure produces strains in the strut and the gate leaves. As the tidal rise at Chemulpo is very rapid, at times over 1 in. per minute, the stresses would become excessive within a very short time. It was therefore thought best to have the gates open automatically, especially as it is not easy at night to tell just when the levels balance.

The proposed protective device should be entirely effective. It consists of an electric switch similar to the cut-out switch mentioned, and is also fastened to the operating strut. When the reversed water pressure acts on the closed leaf, the strut shortens, and its two sections slide on each other. As soon as this movement has reached any desired amount the switch starts the motor and opens the gate. It is proposed to attach these switches to all the gate leaves, as the reversed head may occur at both ends of the lock.

PERSONNEL

The general contract for the lock equipment was awarded through Mitsui & Company, Inc., to the McClintic-Marshall Company of Pittsburgh, which built the miter gates at its Rankin plant. The machinery was manufactured by the Fawcus Machine Company, and the electric equipment by the General Electric Company. Some of the heavier iron castings were made by the Davies & Thomas Company at Catasauqua, Pa.

The general and detailed plans were prepared by Henry and C. J. Goldmark, consulting engineers, of New York City, who also supervised the construction on behalf of the harbor authorities. N. Sakaide is the government engineer in charge.



DETAILS OF VALVES AND MECHANISM FOR RAISING AND LOWERING THEM

Cord Wood Shrinks 25 Per Cent in Sawing

Two students of the University of Washington, working under the direction of the College of Forestry, have found that a cord of full-length wood when sawed into short lengths and repiled in the ordinary stack shrinks on an average about 25 per cent. For close piling in which all the sticks are carefully fitted together the shrinkage is about 13 per cent.

Discuss Illinois Bridge Specifications

Chicago Association of Commerce Committee Gets Opinions of University Professors on Permissible Unit Stresses in Concrete Structures

THE adequacy and economy in the design of the concrete highway bridges of Illinois have been under investigation as a part of the work of the good-roads committee of the Chicago Association of Commerce. Founded on correspondence with various university bridge departments, the report indicates that the specifications are high grade, although they might be modified in a few instances. Points with reference to loading, stresses and use of high-carbon steel are given below.

An explanation of certain clauses in the specifications was furnished by W. W. Marr, state highway engineer. As to live loads for concrete bridges, he states that the expected life of concrete bridges is considered so much greater than that of steel bridges that the loads are assumed considerably higher than for steel structures. As an alternative to a live load of 125 lb. per square foot, the load diagram used is the approximate equivalent effect on a reinforced-concrete slab of a 24-ton steam-plow tractor, and is probably as satisfactory as any that may be devised for use, considering the heaviest motor trucks now known. Such loads are as yet unknown on county highways in Illinois. Prof. F. E. Turneaure, University of Wisconsin, stated that he did not consider this assumption excessive.

CONCRETE ARCHES

Illinois does not permit concrete arches unless founded on solid rock or unusually firm hardpan, except for paved culverts and very small paved bridges. Professor Turneaure called attention to the fact that a number of arches in Wisconsin have been built on pile foundations driven in good, firm soil, with entire success; also two arches on gravel foundations without piling.

With reference to concentrated loads on steel bridges, Mr. Marr said that with concrete floors the Illinois specifications call for a uniform live load of 1440 lb. per foot of floor slab on the concrete subfloor slab. In explanation he stated that this is the approximate equivalent to the heaviest concentrated motor-truck wheel load to be expected. It is based on the maximum stringer spacing allowed, which in turn has been found to represent the approximate economical maximum. This provides a floor slab having a total thickness of about 4 in., which is about the minimum thickness that can be constructed and cured satisfactorily without using extraordinary precautions.

"Just what assumptions," Professor Turneaure said, "should be made with regard to the load on the portion of the concrete floor under the drive wheel of the traction engine, particularly if the same has sharp lugs, is problematical. The writer does not believe that an assumption of 1440 lb. per square foot of floor slab is at all excessive."

HIGH-COMPRESSION UNIT STRESSES EXPLAINED

For reinforced slab structures the Illinois and Wisconsin permissible stresses, in pounds per square inch, are as given in the table.

For reinforced-concrete girders the compression is 1000 lb. in Illinois and 700 lb. in Wisconsin. For plain and reinforced-concrete arches it is 800 lb. in both states.

Mr. Marr says: "Considering the length of span for which girders are used, the probability of the maximum load coming upon the structure is considerably more remote than in the case of simple-slab bridges. The uniform live load produces the greatest moment in the girders, except for the shortest girder spans. In short, for through-girder spans the girders are arbitrarily increased in depth and width beyond that theoretically required to afford protection to the traffic as side rails and for appearance.

"The only load which may now be anticipated which might approximate 125 lb. per square foot on a 16-ft. roadway bridge over a length as much as 50 ft. is that of a string of 7 cu. yd. trailers hauled by a steam tractor. Such an outfit was purchased by the State Highway Department some years ago and produced the equivalent load of about 110 lb. per square foot over a width of 16 ft. and a length of about 50 ft. The use of this outfit has been virtually abandoned because it has been found impracticable to provide road surfaces to accommodate the load. Should such loads occur in the future on county highways, they would undoubtedly be rare. The dead-load stress is under that recommended by the Joint Committee.

THROUGH-GIRDER BRIDGE TESTED

"A 40-ft. clear span, 18-ft. roadway, reinforced-concrete through-girder test bridge was built at the Southern Illinois penitentiary and was subjected to various test loads. A live load equivalent to thirteen times the live load used in designing was imposed for four days in an attempt to break the bridge. No failure occurred. A load equivalent to eleven and one-half times the designing load (1450 lb. per square foot) was left in place for more than one year and no failure occurred (see 'Test of a 40-Ft. Reinforced Concrete Highway Bridge' by D. A. Abrams, *Proceedings* of the American Society for Testing Materials, Vol. 13, 1913). The observed stress in the girder steel was only about one-half that computed by the usual formula, considering each girder as a unit independent of the floor. Loading the bridge to destruction has been abandoned.

"Considering the probable rare occurrence of the maximum load, the age of the concrete when such a load may be expected and the behavior of the test bridge above mentioned, the compressive stress allowed for concrete in girder bridges is not considered too high. In deck-girder bridges, on account of the floor slab forming a part of the area in compression, the concrete stress is low.

"Compression in arches is lower than for girder bridges because of uncertain temperature effects and on account of the effect of the possible nonrigidity of foundations.

PERMISSIBLE STRESSES FOR REINFORCED SLAB STRUCTURES

	Wisconsin	Illinois
Tension in concrete.................	None	None
Compression in concrete (Class A)	700	800
Shear (diagonal tension) in concrete when no shear reinforcement is provided	30	40
Shear (diagonal tension) in concrete when reinforcement is provided for shear in excess of 40 lb. per square inch...................	120	120
Bond between reinforcing steel and concrete (surface area).........	120	80
Tension in reinforcing steel.......	16,000	12,000

"Extensive tests made under the direction of Prof. F. O. Du Four and the State Highway Department have indicated plainly that impact may be disregarded in the design of such bridges as are provided by these specifications.

"In general," said Professor Turneaure, "there is very little difference between the two sets of specifications. I think that the allowable stress of 80 lb. of the Illinois specifications is better than the 120 lb. of the Wisconsin specifications. Relative to girders I should say that the 1000 lb. allowable stress on concrete was high. I should prefer the Wisconsin rule."

COMMENTS ON SPECIFICATIONS

The comment of Prof. O. H. Basquin, Northwestern University, is as follows:

"The compressive stress in concrete girders seems too high, even in view of the explanation. Nothing is said as to the method of estimating these stresses; therefore these are the actual stresses. The explanation would rather indicate that the method of estimating the stresses in the bridges tested may be in error.

"The compressive stress in concrete seems too high for plain concrete arches and perhaps also for those that are reinforced."

N. B. Garver, instructor in highway bridge engineering, University of Illinois, wrote with reference to the specifications in general as follows:

"My opinion is that in the main the specifications depend primarily upon the loadings and unit stresses specified. In the light of experiments that have been made I believe these specifications to be safe and economical. My reasons for that belief are based on the evidence which appears in the following published articles." Ten references were given.

PROHIBITS HIGH-CARBON STEEL

"High-carbon steel is prohibited in the Illinois specifications," said Mr. Marr, "because the added cost of bending in scattered bridge work makes it uneconomical. In addition, much trouble has been experienced from breakage due to rough handling and during bending."

Professor Turneaure agreed with Mr. Marr on this point and added that the high-carbon steel was not so reliable as mild steel.

Geodetic Survey Party Adopts Auto-Truck Transport

Observations have just been completed by the U. S. Coast and Geodetic Survey on an arc of primary triangulation 630 miles long from northern Utah to northeastern Oregon and thence to Portland. For the first time on this class of work the surveying party was transported by automobile truck, and as a result of the experience with them all parties engaged on similar work are to be provided with this means of transportation. The truck carried the party to the bases of the peaks from which observations were made, the equipage and instruments being transported to the top by horses or members of the party. Most of the observations were made by night, using acetylene lamps for sights. Observations were made from end to end of one line 134 miles long in this way. The elevations of a large number of mountain peaks were determined accurately by triangulation for the first time by this survey. The party was in charge of C. V. Hodgson.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

George's Opportunity

SIR: I respectfully suggest that the American Society of Civil Engineers adopt as its motto for the coming year the familiar slogan, "Let George Do It," as the nominees for the ensuing year are: President, George Pegram; vice-presidents, George Kittredge and George Webster; and treasurer, George Tillson.

New York City. FREDERICK H. POND.

Information Wanted on Turnouts for Concrete Roads

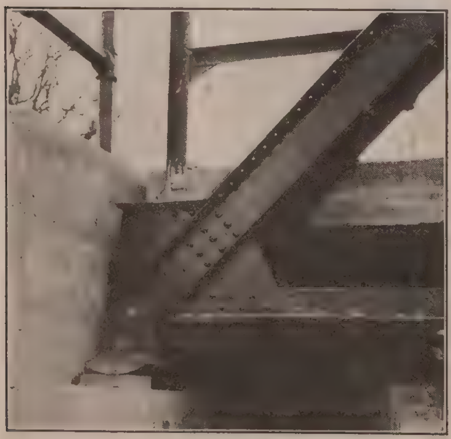
SIR: Can you tell me where I can get some information on the omission of shoulders on single-track concrete roads and the use of turnouts? The turnouts are to be, say, 6 ft. in width and 40 ft. in length, and be placed at 500-ft. intervals on alternate sides of the road. If you can give me the names of any engineers or communities that have used this construction I would appreciate it.

Greenville, Miss. A. R. ALLING.

Cast-Iron Rocker Shoes Successful

SIR: In an article on the steel-bridge standards of the Iowa Highway Commission in the Engineering Record of Dec. 12, 1914, page 631, the writer made brief mention of the rocker shoes used on truss spans 70 ft. or more in length. No details were given at that time. In view of the fact that this type of expansion bearing has been used successfully for several years, the accompanying details and photograph may be of some interest.

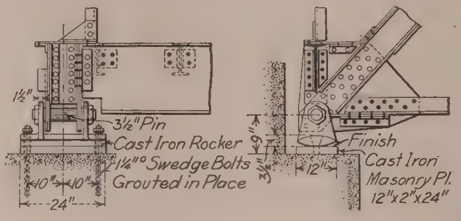
The usual type of roller bearing with rollers from 2 to 4 in. in diameter, in general use for highway bridges, is very unsatisfactory because it soon clogs with dirt and rust and is practically never cleaned. The rockers as shown were designed to overcome this objection. They were first suggested and used in some of the earlier designs of the commission by Prof. J. E. Kirkham of the Iowa State College, and, so far as the writer knows, the use of this type of expansion bearing for highway bridges is original with Professor Kirkham.



CAST-IRON ROCKER IN 110-FOOT SPAN

In the earlier designs the rockers varied considerably in dimensions and minor details, but the bridge designs have since been standardized, and for the past three years they have been built as shown in the accompanying details, which are for a standard 110-ft. through riveted truss span with 16-ft. roadway and concrete floor. The rockers have been used for bridges with concrete floors, and of span lengths up to 150 ft. For the longer and heavier spans the thickness of the vertical webs and of the masonry plate is increased. The masonry plates are made of such area that the pressure on the masonry is limited to 400 lb. per square inch. The rockers are anchored to the masonry with 1¼-in. swedged bolts passing through the rocker portion as shown. The wedge-shaped anchor bolt slots provide for the free expansion and contraction of the trusses.

It will be noted that the standard rockers are of cast iron rather than cast steel. The principal reasons for this are that good iron castings are more easily obtainable in small shops than good steel castings, and the iron castings are the cheaper. The same type of rocker bearing is adapted to long-span plate girders by the use of an upper cast shoe bolted to the sole plate of the girder and connected to the rocker pin.


1½"
3½" Pin
Cast Iron Rocker
1¼"⌀ Swedge Bolts Grouted in Place
10"
10"
24"
9"
3½"
12"
Finish
Cast Iron Masonry Pl. 12"x2"x24"

DETAILS OF ROCKER AT EXPANSION END

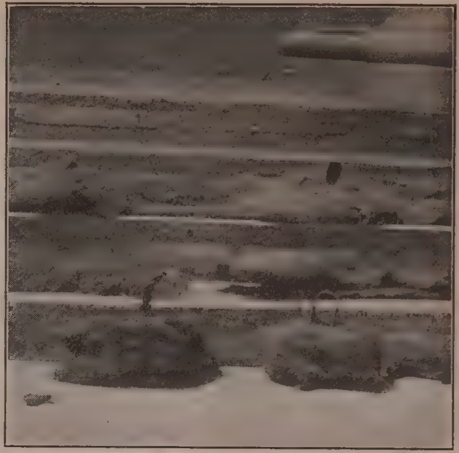
The cost of the cast-iron rockers compares favorably with that of roller bearings, and the results have been much more satisfactory than could have been expected with the latter type of expansion bearing.

E. F. KELLEY,
Assistant Bridge Engineer, Iowa State Highway Commission.
Ames, Iowa.

Roots Grow Rapidly in Sewer

SIR: In the accompanying illustration is shown a six months' growth of elm roots in a 12-in. storm sewer. All were taken from a length of about 30 ft. The section of storm sewer from which these roots were taken was thoroughly cleaned in December, 1915. Recently, after a heavy rain, it was noticed that the water did not get away from this section properly. Upon investigation the trouble proved to be roots, most of which were raked out. The remainder were removed by the machine.

This sewer, which was constructed about six years ago, was not laid to a true grade, there being a rise toward the outlet sufficient to hold water the full depth of pipe at the clogged section. This has been an exceptionally dry season and has caused the roots to search the sewers more vigorously for water.



ELM ROOTS GROW IN A 12-INCH STORM SEWER

Fortunately there is another storm sewer across the street, low enough so that by laying a cross-connection the defective sewer can be thoroughly drained, thus removing the constant water supply which gave the roots such rapid growth.

C. E. HENDERSON,
St. Augustine, Fla. City Engineer.

Quality of Concrete—and of Engineering Supervision

SIR: Under the caption, "Quality of Concrete," you have an editorial in your issue of Nov. 11, page 577, commenting on the report of a bridge failure at Independence, Ore. This editorial brings to mind the old expression that "you cannot legislate efficiency"—and so it is with a specification, "you cannot legislate proper construction." You can suggest and direct that such and such things shall be used and performed, but the result depends, more than on this, on the man who is doing the directing; that is, the inspector, and on the engineer or other person delegated to supervise the construction. A set of plans and specifications can be ever so carefully drawn, but unless the work is delivered into the hands of competent and honest inspectors and competent and honest supervising officials, what is the use?

I do not believe I am exaggerating when I say that at least 50 per cent of our public improvements are improperly inspected. And why? Simply because we, as engineers, are content to sit tight at the critical time and criticise afterward. We do not bring the matter home with sufficient force to the political officeholder that competent inspection is one of the main essentials of successful work. We object probably in a weak sort of way, but not convincingly, and the result is that some political supporter or personal friend of the officeholder gets the job.

It is the general supposition of the layman that all that is necessary for successful inspection is to have somebody on the job; no matter who it is, just so he is on the job. The engineer will see to it that the work is being done right, that's his business. The job fails, and the engineer gets the blame. Why shouldn't he? If he is so timid as to tolerate such an organization for the carrying out of the work he has so carefully planned he deserves to get the blame.

You never see a lawyer delegating to an

incompetent the defense of an important case which he has gone to considerable trouble to prepare; nor a doctor a serious and complicated operation. They either go through with and dictate the policies of the procedure or else they do not act. And so it should be with engineers; they should hold out for the final say as to who shall supervise or inspect, or else refuse to act.

Nor can you always lay the blame for poor inspection on the political officeholder. How often do we see the engineer, who is given absolute authority for creating his construction organization, hire cheap help for the sake of saving a few dollars. Cheap help as a rule denotes incompetence. Low pay is conducive to dishonesty. In this age we usually get just what we pay for. Cheap help means cheap work; a cheap contract, trouble.

So I say it is up to the engineer to see, first, that he has competent assistants; second, that the contractor is to receive a reasonable price for his work, and, third, that the work is done properly. Every failure discredits not only the engineer who had charge of the work, but also the whole profession. The greater the number of failures, the greater is our discredit in the minds of the public.

Another matter which you refer to and in which I cannot concur is that of specifying the strength a concrete shall attain within a certain specified time. Theoretically this is good, but is it practical? I think not. If I get the correct impression, you would take samples of the concrete as it was being run, and then at the expiration of the required time, test it and find out if the job complied with the specifications. In the meantime the work has continued and possibly has been completed. I suppose the remedy would be to tear it down and try again.

This is exactly where most of our trouble comes under the present system. The error is committed but not discovered until some time later. To correct it would necessitate the removal of considerable other work which apparently is good, so we take a chance. Like all other forms of gambling, we win sometimes, and sometimes we do not. When we do not win, it is a failure.

It is my belief, and I think the majority of the profession will agree with me, that the proper time to stop faulty work is while it is being done, and that the time to catch faulty materials is when they are being delivered. If sufficient care were used at the time the specifications are drawn to obtain a correct knowledge of the materials available and draw the specifications accordingly, and if we would then see to it that the conditions during construction are carried out as they should be, we should have far fewer failures and far less criticism.

Summing the whole situation up, we come to the following conclusions: First, an engineer should not accept a commission until he has some assurance that suitable provisions will be made for carrying out the construction end; second, he should give careful consideration to the selection of the materials, the conditions under which they are to be used, and all local conditions likely to affect the quality of the work, then limit the requirements of the specifications to these conditions; and, third, he should not be found guilty of practising false economy or of having a philanthropic feeling for the contractor.

G. C. PRUETT,
City Engineer.
Miles City, Mont.

Derricks on Yadkin River Power Project

SIR: Referring to the article in your issue of Nov. 18, page 610, on the Yadkin River power project, we wish to call your attention to an omission in regard to the equipment. You speak of the American Hoist & Derrick Company's derricks being used on this work, but you do not mention the hoisting engines.

These derricks are operated by 9 x 10 double-cylinder tandem-drum Lidgerwood hoists, with their patent bullwheel swinging gear.

We designed a special derrick engine for the Hardaway Contracting Company, for use on its different contracts. The design is generally that of our standard derrick hoist, but made with larger-faced swinging drums, which necessitated heavier gears and heavier shafts. The hoisting drums are fitted with non-burn Autobesto lined brakes, two on each drum. Mr. Hardaway's desire was to have a hoist that would withstand every abuse.

LOCATION OF HOISTING DERRICKS DURING THE JULY FLOOD

Mr. Hardaway has so far as possible standardized all his equipment, as this simplifies the matter of repairs, and also his men when shifted from one work to another are familiar with the apparatus they have to handle. This is an important advantage where comparatively unskilled labor is used.

We have sold to the Hardaway Contracting Company 127 hoists, steam, electric and air-driven, since it commenced standardizing its equipment, and are building twelve more for that company at the present time.

We inclose a photograph taken during the floods, showing the location of these derricks.

LIDGERWOOD MANUFACTURING COMPANY,
John Sinclair,
Manager Advertising Department.

Experts Overnight

SIR: I read with much interest the editorial in your issue of Nov. 18, page 607, entitled "Experts Overnight." I beg to suggest, however, that there may be another side to the story.

As no detailed information is given as to the exact conditions surrounding the junket in question, I will speak only in general terms. Men occupying the positions mentioned are mostly men of the world, of mature age, possessed of tact and common sense and under no illusions as to their own ability to become expert sewage-disposal engineers overnight. The majority of them, the country over, are honest men, anxious to do their best for the community. It is not uncommon for them to go, individually, at their own expense, to examine work similar to some that may be proposed in their own town. Very frequently they do the same thing while on business or pleasure trips to other towns in the country, or even abroad. Their work in connection with a sewage-disposal plant is fully as important as, and often much more difficult than, that of the engineer, and they are seldom paid for it except with abuse.

Sewage-disposal plants cost large sums of money, which usually means a bond issue authorized by popular vote. In other words, the voters must be convinced of the wisdom and desirability of the expense. This often requires years of hard work. Experienced public officials understand perfectly that they are not by any means their own masters; they must convince their constituents of the wisdom of their acts. They have to deal with the hostile press, the reptile press, the conservative press, the unwise friendly press and the technical press—although few read the latter; they are all mouthpieces of appropriate elements in the community. Property owners, who are usually influential people, dread the increased taxes, while other important groups of people would prefer to have the money spent for civic centers, school houses, parks, playgrounds, waterworks, street cleaning or hospitals. Successful politicians realize that they must lead public opinion, but must never advance so rapidly as to get out of touch with it; otherwise all their projects will be wrecked.

Whenever a sewage-disposal proposition is agitated every politician, public official and prominent citizen who is supposed to have any say in the matter is besieged by a multitude of engineers, contractors, patentees, etc., every one of whom presents a proposition which he insists is the very thing and the only thing. These propositions differ widely in character and estimated cost. Some of the proposers are honest and capable and some are not. The officials are well aware that an engineer must be selected, but whom shall they select? Their information on that subject is by no means as extensive as yours, Mr. Editor.

Many patentees maintain competent staffs of engineers who have made a specialty of that work. Their experience is wider than that of anybody else except a few famous experts, and they are usually willing to do the engineering work and take their pay in the form of a royalty. Many contracting companies also maintain competent staffs of engineers, and they have the advantage in that they can be held responsible for their preliminary estimates and for the successful operation of the plant, as well as for patent infringements. A competent independent engineer is best of all, but many engineers have a personal equation in the form of a percentage which must be added to their preliminary estimates to cover the total cost of the work. This percentage varies from 10 to 50 or more. Appropriations and bond issues for public works must generally be sufficient to complete the work, in order to make the contracts legal, and if a supplementary appropriation is required the public officials are subjected to a great deal of very awkward questioning.

An agitation for an important public work can hardly get far until the public is reliably informed as to the roughly approximate total cost of the proposition. A competent engineer would hardly risk his reputation on a preliminary estimate without an investigation which might cost thousands of dollars. There are no funds available. What more natural thing is to be done than to send a delegation of prominent citizens or responsible officials to other cities where sewage-disposal plants are in operation and ascertain how successful they are, under whose patents, if any, they were built, who were the engineers in charge of design and construction, and what was the cost.

Besides, if the project is in the agitation stage the average voter will listen much more attentively to a man who has seen the thing with his own eyes than to the man who has obtained his information at second or third hand, and the officials and politicians are the ones who have to do most of the talking to the public. True, they might have sent the city engineer just as well, but he might be a candidate for sewage-disposal engineer. If an expert, however famous, delivers public addresses as an advocate of the project, the ordinary citizen assumes at once that he is looking for a job.

Harrisburg, Pa. WILLIS WHITED.

Gas Companies Not Opposed to Heat-Unit Standard

SIR: In the editorial entitled "A Profit-Sharing Plan for a Gas Company," published in the Engineering Record of Nov. 18, page 609, there is an inference that the general adoption of the heat-unit standard for gas quality has been delayed in this country due to the gas companies' attitude. This is directly the opposite to the true state of affairs. It is doubtful if there is a gas company in this country which would not cheerfully adopt the heat-unit standard if the utilities commissions permitted it. In fact, at the recent annual meeting of the American Gas Institute a resolution was adopted recommending the total heating value as the only standard basis of rating the quality of all manufactured gas distributed in the United States.

There are various reasons why the artificial-gas industry desires to make its gas to a heat-unit standard. Modern gas illumination, as typified by the gas mantle, depends on the heat value rather than on the candlepower for its efficiency. Long-distance transmission, which has enabled gas companies to extend their services to outlying communities, whose populations in themselves would not justify the investment represented in a gas plant, requires high-pressure distribution. Such a system of distribution is impossible under a candlepower requirement for quality.

The cost of manufacture of heat-unit gas is less than that of candlepower gas, due to the fact that oil has to be introduced in the manufacture of the latter to give it the proper illuminating value. In this connection there is another advantage in that the smoking up of ceilings, walls, etc., is very largely reduced to the point, in fact, where it becomes negligible.

So desirable is the heat-unit standard to the gas company that the company to which you allude, the Peoples Gas Light & Coke Company of Chicago, has spent great sums of money in publicity matter to educate the people of that city up to the point where it might make its proposition for a change in standards. It was not, and is not a case of the company hanging back, but of the public not being educated up to the point where sentiment would not be adverse to the change.

Your editorial would also leave the impression that the adoption of the heat-unit standard is not so general as it is. In addition to Wisconsin, Massachusetts and New York (Second District), New Hampshire, Connecticut, Pennsylvania, New Jersey, Maryland and other states and the District of Columbia have adopted this standard, which is already in effect in Great Britain and Continental Europe. In 1915 Canada also adopted a heat-unit standard on much the same basis as Great Britain's.

Your allusion to the plan to build a byproduct coke-oven plant may lead to some confusion in the minds of your readers. Byproduct coke-oven plants, though large producers of gas, can by no means be substituted for the usual city gas plant. Their principal product is not gas, and in consequence their operation must depend to a large extent on industrial conditions. If the market were glutted with coke, for example, it is quite likely that many would curtail their operations.

During the past few years many of these plants have been constructed and a considerable number are now under construction. Several of them sell their surplus gas to city gas companies, but they in nowise lessen the responsibility of the city companies to have sufficient plant available to supply the demand.

The gas plant in the strict sense of the word is in existence to meet the current demand for gas, and must meet it. It cannot reduce its output at will, dependent upon whether there is a good market for its coke or tar products, as the byproduct company can. These latter companies have come into great prominence as gas producers. It is likely that they will increase in number and output at a rapid rate in the future, especially if proper tariff legislation is passed for the protection of the dyestuffs industry, but they are not gas plants, as the gas industry understands the term.

The editorial on the whole is, in my opinion, extremely valuable, and carefully considered. The facts as presented reveal a good general knowledge of the existing conditions in the gas industry, and it cannot but have the effect of directing your readers' attention to an industry they should know a great deal about, concerning which, nevertheless, they in reality know very little.

EUGENE C. MILES,
Editor, American Gas Light Journal.
New York City.

Warehouse Footings Rest on Concrete and Sand Piles

SIR: The following piece of construction may be of interest to the readers of the Engineering Record. It was interesting to the writer, as it is new in his experience.

Our company built a five-story reinforced-concrete warehouse for the Kansas Ice & Storage Company of Salina. The building was completed this summer and is now in use. All footings rest on 9-in. concrete and sand piles, the accompanying illustrations showing a typical interior footing.

The following tests were made on this type of pile by R. H. Short, manager of the plant and designer of the building:

SAND PILE 6 INCHES IN DIAMETER

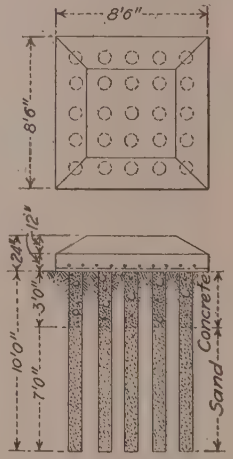
Load, lb.	Settlement in 24 hours, in.
7,600	⅛
11,100	*¼
14,420	*1

SAND PILE 9 INCHES IN DIAMETER

Load, lb.	Settlement in 24 hours, in.
4,520	⅛
7,950	*¼
11,170	*1

*Total settlement.

The variation in the result of two piles was probably due to variation in the soil, which is a sandy loam. The test piles were about 100 ft. apart. The tests were made by setting a large box on a pipe with a plate on the end, which rested directly on the sand. The box was then filled with shot. Readings from the benchmark were made with an ordinary level.



TYPICAL INTERIOR FOOTING OF WAREHOUSE

Holes drilled with post-hole auger, filled with sand and tamped as filled. Cap and top of pile poured at same time.

EBERHARDT CONSTRUCTION COMPANY,
D. B. DUNCAN, Vice-President.
Salina, Kan.

Dams in Pennsylvania

Fifty-one applications for the construction of new dams were received or considered by the Water Supply Commission of Pennsylvania during the year 1915 and forty-three permits were issued. This information is contained in the commission's latest annual report. Three of the proposed dams exceeded 40 ft. in height, the maximum height being 68 ft. Twenty-nine applications for permission to make changes or repairs to existing dams were received and twenty-three approved. Construction work was continued on thirty-two projects under permits issued prior to 1915. The number of existing dams examined was 348, and repairs or alterations were ordered on 121 of these. The total number of field examinations made in connection with dams was 626.

HINTS FOR THE CONTRACTOR

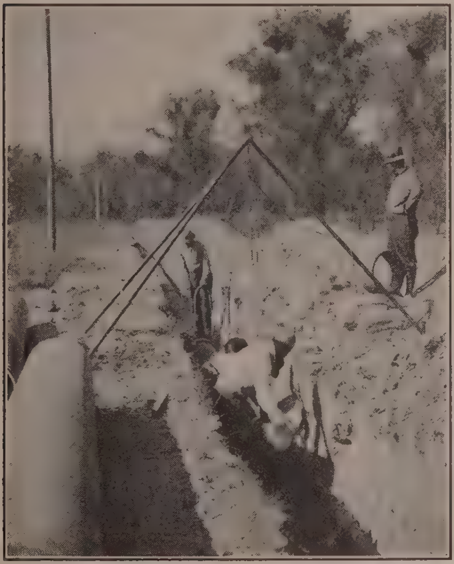
Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, *and should be accompanied, if possible, by photographs or sketches.*

Tripod Used to Swing Ram on Pipe-Laying Job

IN LAYING the 18-in. pipe for the Lindsay-Strathmore irrigation project in California the plan of using a 200-lb. ram for driving the pipe into place was tried out instead of employing hand sledges in the ordinary way. The ram was swung by block and tackle from a tripod made up, as shown in the illustration, of 2-in. pipe.



SWINGING RAM DRIVES PIPE HOME

Working with machine-banded pipe in 12-ft. lengths and with slip joints fitting into couplings, it was found that on this work the crew of five men and foremen completed in the trench an average of 1100 ft. to 1200 ft. in a nine-hour day.

This is about an average rate of progress whether the pipe is driven home by means of sledges or by the device shown. The Redwood Manufacturing Company, which holds the contract on this work, pointed out that although the time required in shifting the apparatus almost offset the time saving which its use effected, the use of the tripod made the work much easier for the men.

Lime Used to "Blast" Old Foundations Between Running Machines

SEVERAL hard brick foundations for large blowing engines were taken out a number of years ago at the Edgar Thomson Steel Works of the Carnegie Steel Company, at Braddock, Pa., by loading holes drilled in them with lumps of freshly slaked lime. The foundations were located between other blowing engines which it was necessary to keep in operation, and blasting was considered dangerous, while chipping the old foundations out by hand would have been very expensive and slow.

The old foundations were about 12 x 20 ft. in plan and 12 ft. high. Holes were drilled into the top face 3 ft. apart each way. Each of these holes, 3 in. in diameter and 3 ft. deep, was first filled to a depth of 1 ft. with 1½-in. to ½-in. lumps of freshly slaked lime, and sufficient water was poured in to cover the lime. Then another foot of lime and more water was added, filling the hole within 6 in. of the top, after which the top of the hole was filled with brick drillings rammed tightly. The holes were filled this way one at a time, in order. After about 10 minutes, cracks would start in all directions from the first holes filled, and in a short time after all the holes were loaded the entire top of the foundation would be broken into pieces approximating 3-ft. cubes. This was the largest size that could conveniently be removed by hand, but the foundation might have been broken into chunks of any size by varying the depth and spacing of the holes. The holes had to be loaded rapidly, and the workmen were kept off the top of the foundation after the loading was finished, as on one occasion the tamping blew out of a hole. The method made no dirt and no noise, and involved no danger of damage to the moving machinery less than 10 ft. away.

Ramps on Both Sides of Dumping Platform Save Time

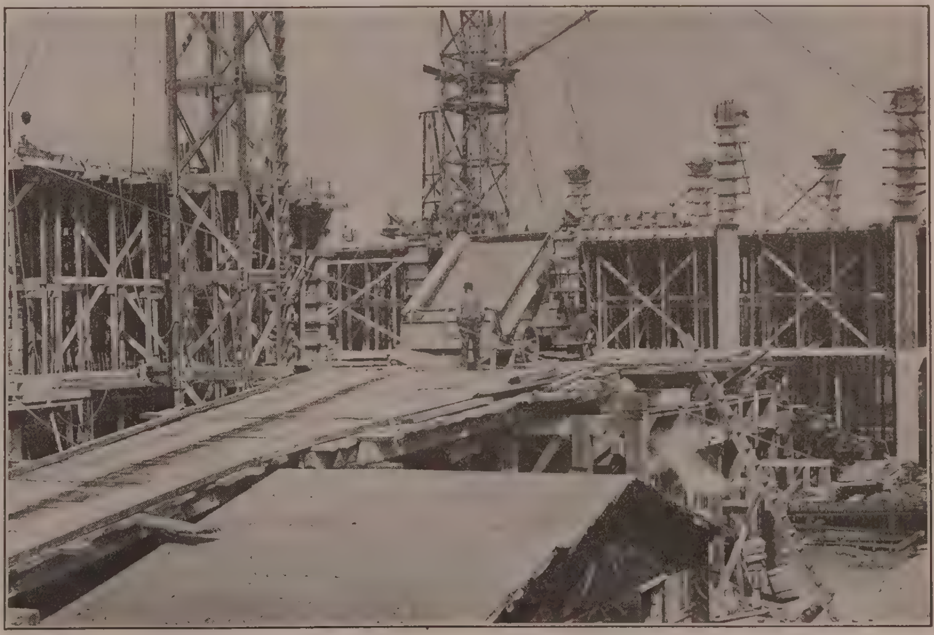
A DUMPING platform with inclines on both sides is being used to unload motor trucks of the Cleveland Builders' Supply Company in constructing the $500,000 reinforced-concrete building of the Richman Brothers Company in Cleveland. With this arrangement the trucks do not have to turn around or back away after dumping, but drive straight across the bins and down on the other side. The nine back-dumping White trucks employed on the job discharge their loads through holes over the bins in the plank roadway. The truck wheels are kept from going into these holes by timber guard rails which the trucks straddle. Plank "splash" boards resting on short posts and on these guard rails are placed behind the truck by the dumpman to keep material from spilling over the wheel tracks. The trucks follow each other very closely, as concrete is mixed and placed at a rapid rate, and the double runway is said to save considerable time in dumping.

Release Valve Maintains Pressure in Highway Water-Supply Line

By HARLAN H. EDWARDS
Urbana, Illinois

IN ORDER to maintain a uniform pressure in the discharge line of a piston pump a simple weighted pressure-release valve is being used by an Illinois highway contractor. The valve is in a pipe line supplying water for a concrete mixer on the thin-base monolithic brick-pavement construction of Bishop and Liddell, near Milford, Iroquois County, Ill. A T was inserted in the discharge line, to which were fitted a nipple and a valve. A waste pipe was run from the valve to a ditch near by. In operation the pump is run continuously by a gasoline engine, and the pressure is regulated by placing the weight at any desired point along the lever arm. In this way the pressure at the mixer, wherever it may be along the road, can be maintained constant by a small movement of the weight.

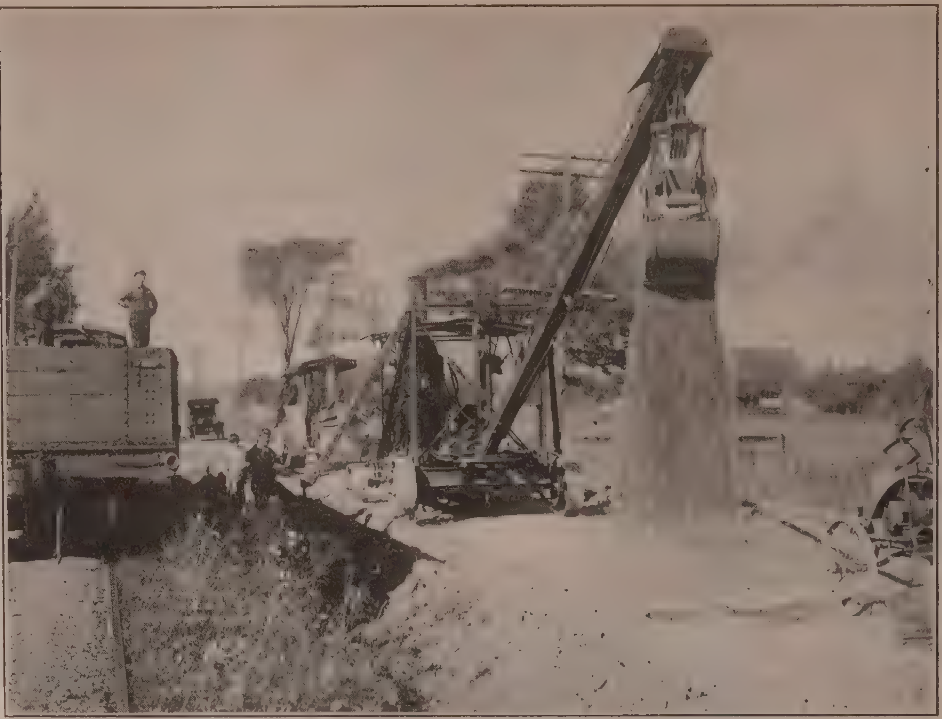
The use of such a valve insures a continuous supply of water in reliable volume and smooth running of the pump without constant attention.



UP ONE SIDE AND DOWN THE OTHER—TRUCKS STRADDLE GUARD RAILS OVER DUMPING GATES

Light Crane Unloads Stone and Hauls Scraper to Spread It

THE Harrison Engineering & Construction Company in resurfacing a road near Buffalo, N. Y., has taken advantage of a parallel electric-railway line to develop the novel method of unloading and spreading road metal shown in the photograph. The stone is delivered in gondola cars on the electric road, unloaded by a Byers Auto-Crane and dumped in the center of the road in front of a wheeled scraper. The scraper is hitched to the crane, and as the latter piles up stone in the roadway it backs away, drawing the scraper after it and spreading the stone. The car of stone is kept within reach of the crane by the electric locomotive. It can readily be seen that work done in this way progresses much more rapidly than with hand unloading and spreading, to say nothing of the great reduction in the size of the crew required.



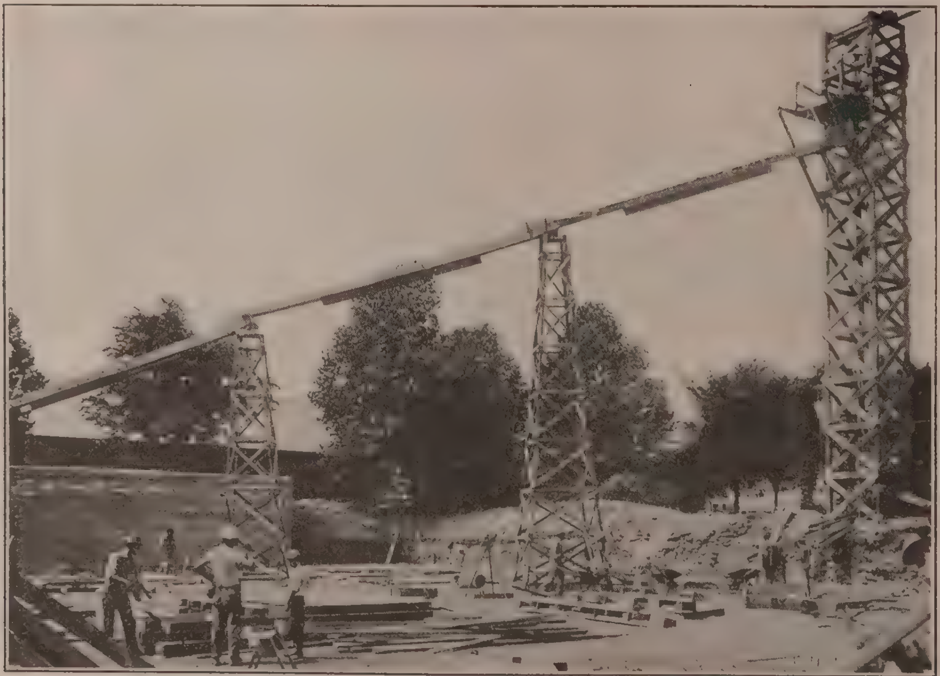
SCRAPER HITCHED TO CRANE SPREADS STONE UNLOADED AS LATTER BACKS DOWN ROAD

Light-Wood Spouting Plant Saves on Small Remote Job

By JOHN A. HAMILTON

Monongahela Valley Water Company, Elizabeth, Pa.

THE PLANT shown in the photograph was used by the writer to distribute the 1100 yd. of concrete in building a 1,000,000-gal. clear-water basin, and should prove economical on other comparatively small jobs where steel spouting equipment is not available. The main tower was 54 ft. high. The three light movable towers, made entirely of 2 x 4-in. lumber, were 36, 26 and 16 ft. high respectively. They were spaced 30 ft. apart, giving the chutes a slope of 1 on 3, on which the concrete ran smoothly. Each section of chute was 32 ft. long and was constructed of 16-ft. 2 x 10-in. plank, with a 2 x 10-in. rib 16 ft. long spiked to the bottom. The ends of the chutes were held together by a single vertical bolt at the towers, which made a swing joint. Handles were spiked to these light wood towers, and it was possible to move the end of the chute line to any point of the 85 x 130-ft. basin in 20 minutes. As steel equipment would have been expensive for this job, the nearest point at which it could have been purchased being several hundred miles away, the wood construction used represented a considerable saving in the cost of the concrete plant.



WOOD CHUTE LINE ON LIGHT TOWERS MOVED TO ANY PART OF BASIN IN 20 MINUTES

Permanently Straighten Drill Rod That Persisted in Bending

By H. S. CARPENTER

Cobleskill, N. Y.

A WELL-DRILL rod which persisted in bending after it had twice been straightened by the manufacturer of the drill was straightened by the writer for the third time last June by compressing the metal at the bend, and has since been giving satisfactory service. The well drill is in service making blast holes.

Since steel can be deformed more easily in tension than in compression, it is likely that the first time this rod was bent the elastic limit of the steel was passed on the convex side of the bend, resulting in permanent displacement of the molecules. When the rod was straightened the first time it was evidently bent back by hammering on the end, or by other means which applied the force to the heated bend in a way that did not recompress the displaced molecules on the convex side, but merely stretched the concave side beyond the elastic limit, resulting in permanent distortion of the rod by increasing its length without reducing its cross-section at the bend. This produced a weak spot in the rod, and it bent at the same point again soon after it was put in service. It seems to have been given the same treatment the second time, which did not improve it, as it bent in the same place for the third time on being put back in service. This time, instead of sending it back to the manufacturer, it was straightened on the job.

Three light rails were laid parallel on the ground and leveled. The stem, heated, was laid across these rails with the convex side of the bend down and the middle of the bend over the center rail. The rod was then hammered on top directly in the concave side of the bend until it was straightened. The hammering was done lightly with an 8-lb. sledge. Striking was continued till the rod could roll completely over and remain in contact with all three rails. In this way the "grain" of the metal at the bend was worked closer instead of being stretched still further, and was restored to something like its original condition. The rod has been in service for several months since and has given no further trouble.

Mechanical Engineers in War Service

Nearly 900 members of the Institute of Mechanical Engineers are known to be in active service, and many others are engaged on munition or other war work.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Massachusetts Commission Issues Bridge Order

As Result of Accident in Which Fifty Lives Were Lost—Bridge Inoperative Until All Gates Are Closed

The Massachusetts Public Service Commission, after an extensive investigation by its inspection department of the accident on Nov. 7, resulting in the loss of nearly fifty lives when an electric car plunged into the Fort Point Channel in Boston after going through the gate at the open Summer Street drawbridge, has issued its finding and also announced its orders for preventing such accidents in the future. The report of the inspection department was made by its chief, George W. Bishop, and is quoted in full in the finding. The orders resulting from the investigation are as follows:

"Every street railway in Massachusetts operating cars or trains over drawbridges on surface lines shall at once establish positive stops at a reasonable braking distance from each drawbridge, subject to the approval of the commission, to protect traffic going in either direction, and shall erect at each stopping place a stop sign visible both by day and night, the type of sign and rules governing its use to be approved by the commission.

"Every such company shall make seasonable application to the proper municipal authorities for the location or relocation, at a reasonable braking distance from each end of each drawbridge, of suitable gates, painted with alternate white and black diagonal stripes and provided at night with red lights located at reasonable intervals on the upper portion, such gates to be properly illuminated and interlocked with the bridge machinery so that the latter cannot be operated unless all the gates are closed.

"Wherever, for any reason, it is found impracticable to secure such location or relocation of drawbridge gates, every such company, provided the necessary consent is obtained from the proper municipal authorities, shall install and maintain, at a reasonable braking distance from each end of each drawbridge, a smashboard signal or similar device so interlocked with the operating mechanism of the draw span as to make it impossible for the drawtender to open the draw before the smashboard is in proper position."

Coroner Calls on Engineers to Propose Safeguards for Bridges

Several prominent people in Chicago recently plunged to their death in an automobile which fell into the Chicago River at the Twelfth Street bridge. Peter Hoffman, coroner, appointed a commission on bridge-safety equipment headed by I. F. Stern, consulting engineer, to make recommendations which could be submitted to the city council for incorporation into a city ordinance. Other members of the commission are John E. Ericson, city engineer; Isham Randolph, L. E. Ritter and W. B. Jackson, consulting engineers; W. R. Morehouse, commissioner of public works, and Charles M. Hayes, president of the Public Safety Commission.

The recommendations call for more illumination, double safety gates, additional signal lights, louder bells and gongs, more clearly defined operation of bridges and interlocking, details for street-car tracks and better police protection.

Of the two gates recommended for each approach, the first is a two-armed light signal gate rotating vertically across the street to be placed 25 ft. back of the break in the roadway. The second heavy barrier gate, capable of stopping automobiles, is to descend in a vertical plane and to be yielding so as to absorb the shock gradually. It is to be placed 5 ft. in front of the signal gate. The apparatus is to be interlocked so that the bridge cannot be opened until these gates are in position.

To keep the matter alive the coroner's commission has been taken over by the Public Safety Commission as a "bridge safety committee." As a memorial to Hugo J. Warner, one of the most prominent of the persons killed, the family proposes, instead of entering suit against the city, "to work untiringly to the end that there may be no repetition of such an accident."

Lower Court Declares Adamson Law Unconstitutional

The so-called eight-hour law was declared unconstitutional by Judge William C. Hook of the U. S. Circuit Court of Appeals, in a decision rendered Nov. 22 at Kansas City in the suit brought by the receivers of the Missouri, Oklahoma & Gulf Railway. This is the first decision in any of the numerous suits brought by various railroads to prove the Adamson law unconstitutional. Judge Hook made it clear that the decision was not based on a careful study of the merits of the case, but was rendered to allow the matter to go at once as a test case to the U. S. Supreme Court.

Trip Through New Sewer in Autos Has Its Joys and Dangers

Inspection of the new south-side storm sewer of Columbus, Ohio, was recently made in Ford automobiles with attendant pleasures and perils—mostly perils, if the account given to the Engineering Record is correct. About twenty automobiles were lowered 20 ft. down the steep approach to the mouth of the passage near Parsons Avenue, and one by one they disappeared into the darkness of the concrete tunnel. Difficulty in negotiating the sharp turns furnished the only thrills during the first part of the journey. Farther along one of the leading cars developed engine trouble, which resulted in a twenty-minute delay. As some of the drivers refused to shut off their motors, the air soon became filled with gas fumes, which caused several members of the expedition to make hasty exits through manholes.

This information was furnished by Charles E. Cannell, of J. C. Carland & Company, Columbus.

Broken Stone Not Permanent Improvement

The local court at York, Pa., rendered a decision Nov. 24 in a case brought by the city against a resident to collect the cost of permanent paving installed on streets upon which broken stone had previously been placed. In deciding for the city, the court ruled that the evidence did not show that piking the highway in 1874 and 1903 was intended as a permanent improvement, and that residents are liable for assessments for improved pavement laid upon such thoroughfares. The action was a test case, establishing a basis for similar actions, where required, against other property owners assessed for paving improvements.

California City Wants Manager

A city manager at $5,000 a year, reports state, is wanted by Marysville, Cal. Experience, honesty and no local friends or relatives are said to be the requirements to be demanded of the applicant.

City Managers Discuss Their Problems at Convention

Delegates from Fifteen Cities Recite Experiences in Municipal Administration—Executive Ability Put Before Technical Training

Qualifications needed in men aspiring to positions as city managers, and methods of training best suited to develop candidates for this specialized branch of public service, formed the main topics of discussion at the annual convention of the City Managers' Association, held at Springfield, Mass., Nov. 21 to 23. Fifteen cities were represented by their managers at the convention, which was only one of ten similar meetings of civic organizations held in Springfield last week. The consensus of opinion semed to be that executive ability, rather than engineering training, was the prime requisite for a city manager. Technical training, it was admitted, was an exceedingly desirable qualification in a city manager, but by no means an essential for his success. A feature of the meeting was the elimination of the formal paper and the substitution of general discussion for it. Specific subjects for discussion were arranged for in advance, and in the program definite time was assigned to each topic, so that the business of the convention proceeded in an orderly, efficient way. There were no postponements or omissions of subjects scheduled in the program. President Henry M. Waite, city manager of Dayton, Ohio, presided at the sessions of the convention.

As a preliminary to their business and technical sessions, the city managers, on Nov. 20, made an inspection of the municipal activities of New York City, proceeding to Springfield in time for the opening of the convention in the latter city on Nov. 21. The first day was given over to reports of officers and committees and to general discussion of such subjects as legal difficulties, budgets, politics, cost records and publicity methods.

Publicity for Bids

There was some difference of opinion as to whether bids for the purchase of city supplies should be made public. It was pointed out that better prices on small purchases can generally be secured when a bidder's figures are not made public. A salesman who puts in a low price does not want his competitor to know about it. Under such conditions, of course, the city is the gainer, but, as Henry M. Waite pointed out, public affairs should be open, and an opportunity should be given to any one who wishes to examine the city manager's books. In Dayton, the city manager is authorized to make purchases amounting to $500 or less without the authority of the commission. Card indexes of current prices are kept, and while these are not given to the press they are open and available at all times. One instance was cited where, after bids had been received, one manufacturer was induced to lower his price. There is danger in this procedure, it was pointed out. If unsatisfactory prices are received, it is best, according to Mr. Waite, to reject all bids and call for new ones.

Understudies for City Managers

One of the subjects which elicited considerable discussion was the training of understudies for city managers. Mr. Waite pointed out that the principle of an understudy for each position is the basis upon which a successful organization must be built up. Men should not be brought in from the outside for these posts, but should be developed out of the existing personnel. Unless this is done, the morale of the organization is destroyed.

Mr. Waite made a forceful plea for the development of men according to their natural bents. Speaking of university courses for the training of city managers, it was held that the tendency of such training is to give the student so many things to think of that he becomes bewildered. "You can't create executive ability in a college course," said Mr. Waite. "It is latent in the individual, and there is no rule for finding out whether it is there or not unless a man is put to work at a job in which he can show whether or not he possesses administrative ability. The final training of the city manager must be in the field and not in the classroom."

A great mistake is being made, according to Mr. Waite, by heralding the commission-manager form of government as a panacea for the troubles of municipal government. This form of government should be suggested only when the people are ready for it. "American people," said Mr. Waite, "don't want to be reformed. They want to reform themselves."

Training for Public Service

In the discussion of the training of city managers, G. C. Cummin of Jackson, Mich., pointed out that the hardest thing for executives to get is a man who will do his own work and at the same time train himself for the job ahead. O. E. Carr of Niagara Falls said that executive ability should come first and technical knowledge second in determining the qualifications of a city manager for his work. Mr. Waite believes that a city manager need not be an engineer. In small towns, he said, engineering training is an advantage, but any good executive, whether he has had engineering training or not, can be a good city manager. C. A. Bingham supported this view, but added that while a city manager need not be an engineer, engineering experience is exceedingly useful.

Dr. W. H. Allen director of the Institute for Public Service, New York City, spoke upon the subject of education for service. His contention was that a man must be developed by placing an actual load upon him; in other words, give him his instruction, not exclusively in the classroom but in some city department. Real experience is necessary. There is to be a future demand for city-manager material, according to Dr. Allen, and it is time now to train men to meet this demand. Apprenticeship in the offices of city managers was spoken of as a desirable form of training, but Mr. Waite pointed out that there should be some clearing house established before raw recruits possessing no particular qualifications for the job are dumped into the laps of city managers for instruction.

The statement is sometimes made that the city-manager plan is applicable only to the small or medium-sized town. The opinion prevailed at the convention that this was not so, and that the city-manager form of government could be successful in a city of 1,000,000 population or more. In a large town the form of organization would involve a division of the work into units, with department heads reporting to a central authority.

Prof. A. R. Hatton spoke of the advantages of broad general training for municipal executives. In addition to this broad training he believes that from 30 to 50 per cent of a candidate's time should be spent in actual practical work in city offices. Then, too, he would exclude from a training course for city service men who do not exhibit characteristics which indicate their fitness for this kind of work. Only picked men should be admitted to preliminary training, according to Profesor Hatton.

Complaints

It has been the practice of a number of city managers to set aside a certain time for hearing complaints. The discussion at the convention developed the fact that this practice has not very much to commend it. It was pointed out that people will offer objections whether or not any specific time is set for them, and that the mere scheduling of a certain night for hearing complaints tends to make people complain who would not otherwise do so.

E. P. Goodrich of New York City spoke of the qualifications for higher executives in municipal administration. Specialization is necessary, according to him. He would combine a university education with technical training and five years in municipal employ. Municipal executives should be grounded in practical politics and know what vote-getting means. It is not only necessary, according to Mr. Goodrich, to report that a certain thing is desirable, but to keep at it until some real working results have been accomplished.

City-Manager Accomplishments

One of the chief advantages of the city-manager form of government, according to the opinions expressed at the convention, was the opportunity it offered to cities to live within their incomes. An interesting feature of the convention was the report by the city managers of their most important accomplishment during the year. For Dayton, Ohio, Mr. Waite reported living within the municipal income. For Jackson, Mich., Mr. Cummin pointed to governmental harmony. For Sandusky, Ohio, K. B. Ward believed that the maintenance of the city-manager form of government was the big feature of the year. C. A. Bingham of Norwood, Mass., placed emphasis upon co-operation of citizens in civic affairs For Winnetka, Ill., R. L. Fitzgerald believed that the establishment of an accounting system was the best thing done in 1916. For Winchester, Va., Arthur N. Field pointed to reduced operating expenses of the city. Elimination of politics was the big accomplishment at Beaufort, S. C., according to H. G. Otis. Rock Hill, S. C., lived within its income last year, according to J. G. Barnwell. According to W. L. Miller, St. Augustine, Fla., under the city-manager form of government, had been placed on a sound financial basis and the debt was decreased 30 per cent. A large reduction in the tax rate was the accomplishment of Niagara Falls, according to O. E. Carr.

The election of officers of the City Managers' Association for the ensuing year resulted as follows: President, O. E. Carr of Niagara Falls, N. Y.; vice-president, Kenneth B. Ward of Sandusky, Ohio; secretary-treasurer, W. L. Miller of St. Augustine, Fla. The next place of meeting was not decided upon, but it will probably be in some city of the Middle West.

To Introduce Bill for Improving Timber Land in Washington

A bill has been designed for consideration at the forthcoming session of the Washington state legislature, covering the development of logged-off or stump lands for agricultural operations. The measure is intended to make available extensive timber properties of the state which are now unworked because of the inability of the owners to finance the clearing. The proposed act provides for the establishment of agricultural-development districts, with limits to be co-extensive with the limits of the respective counties. These districts will be organized by the county commissioners upon the application of fifty or more landowners resident in the county, and will be under the jurisdiction of a commission composed of the county engineer, the county agriculturist and the county auditor.

This commission, or board, will have the power to acquire lands by purchase; to manufacture or purchase powder, caps, fuses and necessary land-clearing equipment, and to operate for the improvement of the land. It will also be empowered to sell powder, caps and fuses to any landowner to an amount not to exceed $1,000, and to lease the land-clearing equipment; to borrow funds and issue bonds to an amount of $250,000 outstanding at one time and to raise revenue by levying an annual tax not exceeding one-fourth of a mill, as well as employ any necessary labor. To carry out the provisions of the act, agricultural development bonds are to be issued, payable not later than two years after date and bearing annual interest not in excess of 6 per cent. The bonds will be considered as preferential investment for the permanent school fund and for all state, county, municipal or other public funds.

Hole Through First of New Subway Tunnels Under East River

The first of the new subway tunnels under the East River in New York City was holed through on the morning of Nov. 28, the final shot being fired from the Brooklyn side. The tube, which met in rock, is one of the pair which cross from Old Slip, Manhattan, to Clark Street, Brooklyn, and which will be operated in connection with the Seventh Avenue line by the Interborough Rapid Transit Company.

The headings of the other tube of this pair are yet about 300 ft. apart. The headings of the second pair of tunnels at this point, which are being built by the same contractor, the Flinn-O'Rourke Company, Inc., from Broad Street, Manhattan, to Montague Street, Brooklyn, and will be operated in connection with the new Broadway line by the Brooklyn Rapid Transit Company, are still some distance apart. Work on them has been delayed by blasting in the channel recently undertaken by the War Department.

In addition to these tunnels the new dual rapid transit system provides for double-track crossings under the East River at Fourteenth Street and at Sixtieth Street, work on both of which is under way. All of these tunnels are in charge of Clifford M. Holland, division engineer for the Public Service Commission, under the direction of Robert Ridgway, chief engineer of subway construction.

City-Planning Engineer Recommended by Milwaukee Council

The first step toward definite city planning, which would set aside certain sections of Milwaukee for residence purposes and others for business and factory sites, was taken at a recent meeting of the council finance committee. It was recommended that the Bogk ordinance to engage a city-planning engineer at a salary of $2,500 per year be passed.

The committee also recommended the adoption of the Bogk resolution to set aside the sum of $18,000 in the 1917 budget as the city's share for rebuilding the floor of the auditorium. The floor rests upon the ground which has been sinking ever since the building was erected. The floor is from 12 to 16 in. out of level. The present rebuilding plans contemplate the removal of the ground underneath the floor and supporting it by piles. This plan would give a firmer support and considerably more exhibition space in the basement. The entire work will cost approximately $36,000.

Consideration was deferred for two weeks on the Bohn and Bulder resolutions to set aside $50,000 and $15,000 for bathing facilities in some of the inland parks.

Property Owners Not Liable for Street Improvement

The Superior Court of Pennsylvania recently handed down an important decision in favor of property owners on Market Street, Pottsville. The court rules that the city cannot collect from owners the cost of installing a second paving on that thoroughfare. The street was improved with wood block pavement, and an assessment of $50,000 made against the property owners to cover the cost of the work. The court says that as this street was macadamized before being paved with wood blocks such must be considered an original paving. The city therefore cannot collect from the property owners the cost of a second paving. This decision affects every third-class city in the state.

Appreciation of Civil Service Examiner

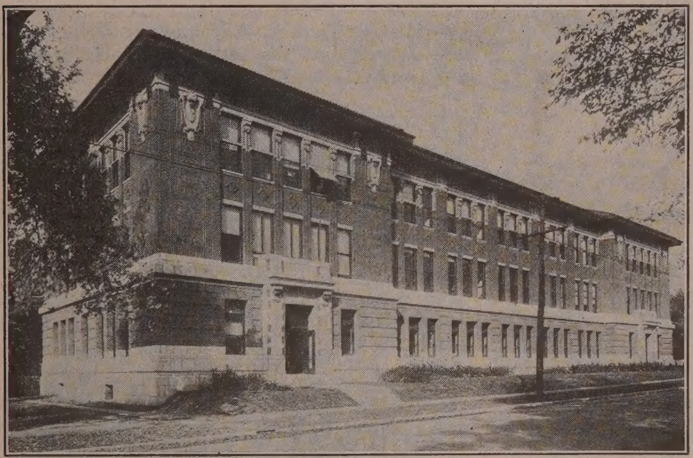
At a recent meeting of the New Jersey Civil Service Commission it was resolved "that this commission express to James H. MacDonald of New Haven, Conn., its gratification on the able and efficient methods employed by him in the recent examination for road inspectors, and its belief that this examination and the one previously conducted by him have set a standard which will greatly aid in an efficient and thorough plan of road inspection in the state of New Jersey."

Stevens Dedicates New Gymnasium

Stevens Institute of Technology recently dedicated its new gymnasium, which was erected at a cost of $125,000. The structure, thought to be the first of its kind to be built elliptical in plan, is the gift of William Hall Walker of New York City.

University of Illinois Will Dedicate New Building December 6 and 7

Formal dedication of the new $250,000 ceramic engineering building of the University of Illinois will take place next Wednesday and Thursday. The list of speakers at the celebration includes Governor Dunn, W. L. Abbott, president of the board of trustees, and S. W. Stratton, director of the U. S. Bureau of Standards. The three-story structure is 67 x 189 ft. in plan, and was made of materials representative of the ceramic arts. Its laboratories are equipped with the latest types of apparatus. Ceramic materials, their development and their uses in highway and structural work, will be the subject of most of the addresses. The formal dedication will take place Dec. 7.



NEW CERAMIC ENGINEERING BUILDING OF UNIVERSITY OF ILLINOIS, WHICH COST $250,000, WILL BE DEDICATED NEXT WEDNESDAY AND THURSDAY

Sanitary District of Chicago to Build Activated-Sludge Plant

Activated-sludge treatment of the sewage of the villages along the Des Plaines River is in the definite program decided upon Nov. 23 by the trustees of the Sanitary District of Chicago. For the 22-square mile area tributary to the Thirty-ninth Street pumping station on the lakefront, settling basins or activated-sludge treatment is recommended. A narrow strip of land along the lakefront is to be acquired for such works. This project is to prevent deposits from being precipitated in the stockyards slip and Bubbly Creek. Likewise, to prevent deposits in the Calumet-Sag channel, sewage originating in the Calumet region is to be treated by sedimentation or otherwise. Evanston's sewage, that from the north shore cities and from the area along the North Branch of the Chicago River, is to be treated. All of these plants are to abate local nuisances and are supplementary to the dilution method.

The definite order passed authorized the chief engineer, George M. Wisner, to prepare plans and specifications for these plants and to present them, with detailed estimates of cost, at an early date.

Engineering Society Activities

British Columbia Division of the Canadian Society of Civil Engineers will hold its annual meeting Dec. 9 in Victoria, B. C.

Engineers Club of St. Louis, at its meeting last Wednesday evening, was entertained with an illustrated description of the Chouteau Avenue viaduct being constructed in St. Louis to eliminate what has been the most dangerous grade crossing in that city since the completion of the Tower Grove viaduct. L. R. Bowen, C. W. Martin and W. R. Crecelius, of the bridge department of St. Louis, conducted the lecture.

Engineers' Society of Western Pennsylvania recently took a "personally conducted" tour, via moving pictures, through the Koppers by-product coke and gas plant of the La Clede Gas Company, St. Louis. C. J. Ramsburg, vice-president of H. Koppers Company, explained the pictures at the meeting held in the Oliver Building, Pittsburgh.

Detroit Engineering Society met last night to hear John W. Batten, engineer of the Detroit Gas Company, discuss the manufacture and distribution of gas. At the Dec. 15 meeting L. W. Spring of the Crane Company will present a paper on the metallurgy and properties of common alloys.

Detroit Chemists will Dec. 21 hear R. Winthrop Pratt, consulting engineer, of Cleveland, and Dr. Hippolyte Greuner, professor of chemistry, Western Reserve University, discuss the proposed method of water purification at Cleveland. The meeting will be held in the Stevens Building, Detroit.

What Engineers and Contractors Are Doing

Manley Osgood, formerly city engineer of Ann Arbor, Mich., has opened consulting offices in that city in the First National Bank Building, as president of the Washtenaw Engineering Company.

R. E. Mohr, formerly engineer for F. J. Hughes & Company, architects and engineers, of Dayton, Ohio, has joined the forces of the Concrete Steel Construction Company, with office at Springfield, Ohio.

Dr. Richard C. Maclaurin, president of Massachusetts Institute of Technology, has been made a director of the Equitable Life Assurance Society, of New York.

Robert C. Terrell, formerly commissioner of roads for Kentucky, is now a member of the faculty of the civil-engineering department of the University of Oklahoma. During his last term of office with Kentucky—1912 to 1916—the state-aid laws were enacted and about $6,455,000 was voted in bonds for the construction of state roads. After graduation from the State University of Kentucky in 1906 Mr. Terrell spent two years on the instruction staff of his alma mater. He was appointed commissioner of public roads for Kentucky in 1908 and reappointed in 1912.

Arthur F. Shuey has resigned from the employ of the Cornell (Wis.) Wood Products Company to become assistant engineer of the Florida State Board of Health. He will report to George W. Simons, Jr., sanitary engineer of the board. Mr. Shuey is a 1916 graduate of Massachusetts Institute of Technology.

W. M. Imbrie, Jr., recently resigned as superintendent of the Chattanooga Chemical Company to become engineer in charge of construction for the Atlantic Pulp & Paper Company, Savannah, Ga.

Louis C. Kelsey, consulting engineer, of Portland, Ore., has opened a branch office in the Twin Falls Trust Building, Twin Falls, Idaho.

George T. Grove has been transferred from the engineering department of the United Fuel Gas Company to the gasoline department, a recently created division devoted to the study of increasing the production of gasoline.

L. O. Marden has resigned as chief draftsman for Oklahoma City to take a similar position in the Highway Department of the State of Oklahoma. Mr. Marden is a graduate of Tufts College.

Harry J. Turner, in the service of the New York State Highway Department, has been appointed junior assistant engineer in the department of the state engineer and surveyor. He is at present located near Buffalo.

A. B. Depuy, Jr., assistant engineer for Remington & Vosbury, civil engineers, of Camden, N. J., has been made resident engineer for the firm on the construction of a sewerage system and disposal plant at Bay Head, N. J.

Nicholas P. Melnikoff, chief engineer of the cabinet of the Czar of Russia, is visiting the larger cities of the Pacific Coast and will soon be in the eastern business centers. He states that he came to America to collect data and to interest Americans in large investment opportunities in Russia, as well as to study industrial methods and plants in the United States.

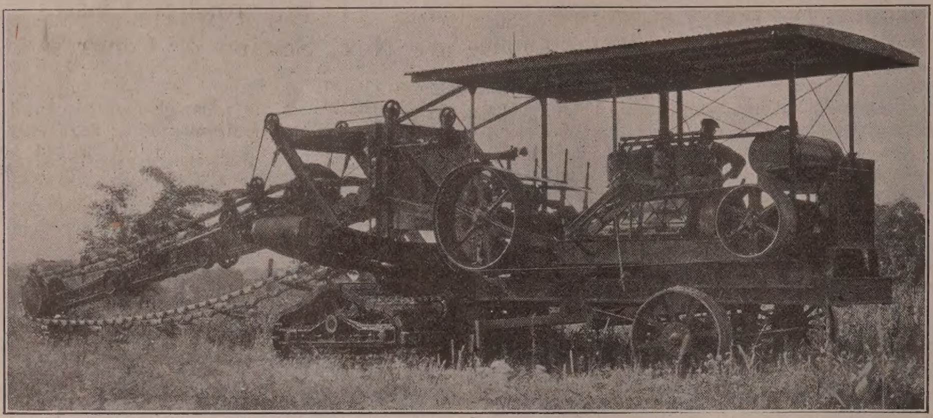
Willard T. Chevalier, formerly with the Atlantic, Gulf & Pacific Company, has just been appointed sales manager of the James Hermiston Manufacturing Company, Inc., New York City (formerly the American Bitumastic Enamels Company). Mr. Chevalier studied engineering at the Pratt Institute, Cooper Union, and Polytechnic Institute of Brooklyn. In 1903 he went with Arbuckle Brothers, coffee merchants, where for a little more than two years he worked in the mechanical department. In 1905 he joined the engineering staff of the Consolidated Telegraph & Electrical Subway Company, New York City. Mr. Chevalier was with the New York Public Service Commission for about two and one-half years as assistant on subsurface structures. His next work was for the Atlantic, Gulf & Pacific Company, for one year on New York Barge Canal work and then on the development of Mill Basin, on Jamaica Bay, Long Island.

Civil Service Examinations

United States—Examinations will be made of eligibles to fill positions in the Navy Department as structural-steel draftsmen, salary $3.52 to $4 per day. Date not stated. Education, training and physical ability are subjects on which applicants will be rated. Examinations will be made Jan. 3, 1917, of applicants for laboratorian qualified in strength of materials, salary $3.04 per day, and Dec. 26 for petroleum economist, salary $1,800 to $2,500. Form 1312 should be filled in for the first two examinations, form 2118 for the last one.

Short-Wheel-Base Trenchers Have All Operations Reversible

In the four new sizes of short-wheel-base trenchers put on the market recently the machines have a reversible action on each operation of traction, digging and conveying. These machines cut a trench from 9 to 48 in. wide and from 6 to 18 ft. deep. Booms on the two larger machines are of the box-girder type, smaller in section at the end, as shown in the photograph. The smaller machines have trussed I-beam booms. Some of the new features claimed are bevel gears and worm drives with ball-bearing thrust joints, a spiral-spring cushion support for the front axle and an automobile type of steering mechanism.



SHORT-WHEEL-BASE TRENCHER DIGS TRENCH 4 FEET WIDE AND 18 FEET DEEP

The range in width of trench is obtained on the larger machines by using two sets of self-cleaning buckets and side cutters, the latter being placed on the digging chain in intermediate positions between the buckets. On the smaller machines two sets of buckets are used, the extra width being obtained by side cutters. The larger machines are equipped with steam or gas power and the smaller ones with Minneapolis Steel & Machinery Company gasoline engines using two-thirds kerosene and one-third gasoline. The machines are made by the Parsons Company, Newton, Iowa.

Steel Company Enlarges

The Midwest Forge & Steel Company, St. Louis, has purchased the Heller Forge Works and the Western Forge Company, which were founded 25 years ago. The Midwest company will continue to produce forged-steel balls, crusher plates and shafts, guard-rail clamps, dipper teeth and similar articles.

For Making Changes on Blueprints

A white water-color fluid used in ruling and lettering pens by means of which changes can be made on blueprints is offered by J. O. Johnston of Rochester, N. Y. "Snow White," as the fluid is known, can also be used in correcting black lines on white paper.

Heat Mixing Water in Salamander

A portable water heater for supplying a concrete or mortar mixer consists of a heavy galvanized-iron salamander in which is placed a coil of 100 ft. of 1-in. pipe. The fire is built on top of the bottom series of coils. Fifty cents' worth of coke will do a day's work, the maker states, which reports a test during an outside temperature of 10 deg. Fahr. in which the water was raised from 36 to 130 deg. Fahr. at the rate of 300 gal. per hour. To give added water or increased heat several heaters may be coupled up in series. The heaters are made by the Londelius & Sons Company, Chicago.

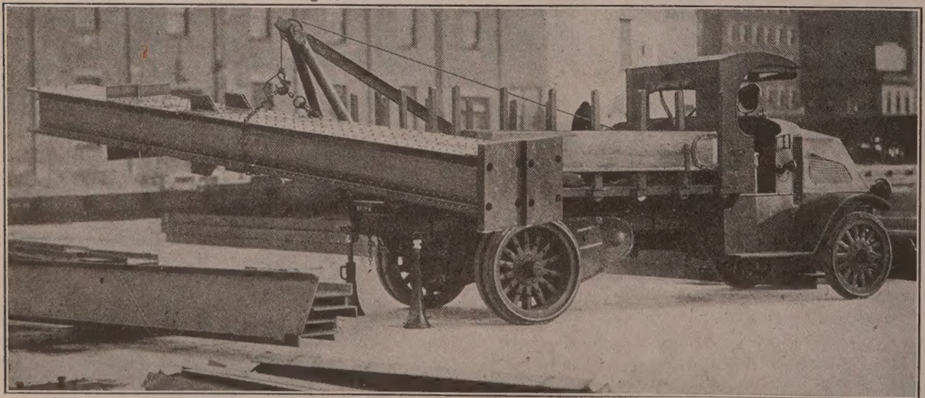
Five-Ton Bucket Holds 200 Cubic Feet

The 5-ton bucket shown in the picture is 15 ft. 3⅜ in. high, 4 ft. 9 in. wide, has a spread of 15 ft. 1¾ in. when open and holds 200 cu. ft. It was made by the Mead-Morrison Manufacturing Company, Boston, for handling ore. The firm is now building a 10-ton bucket which will be 19 ft. 3 in. high when open and 18 ft. high when closed. It will have a spread of 19 ft. 6 in. when open, and its width will be 6 ft. 6 in. The wire rope used on the 5-ton bucket is 1 in. in diameter.

New 3½-Ton Emergency Truck for Boston Fire Department

A 3½-ton Mack emergency and wrecking truck has just been installed by the Boston fire department. The machine is equipped with a power winch, 250 ft. of ⅝-in. cable, removable derrick, drawbar for towing purposes, jacks, skids and all sorts of wrecking apparatus and tools. The equipment can tear down walls, move freight cars in the event of a yard fire, replace derailed cars, pull out trucks stalled in public highways and remove all sorts of débris.

The use of this truck is not confined, it is said, to fire-department service. The construction is thought to make it a practical piece of machinery for the contractor, as the winch can be utilized for hoisting the truck's load to upper floors and for lowering or removing material to and from excavations.



TRUCK WITH ATTACHMENT WELL ADAPTED TO CONTRACTORS' NEEDS

Trade Publications

The following companies have recently issued trade literature:

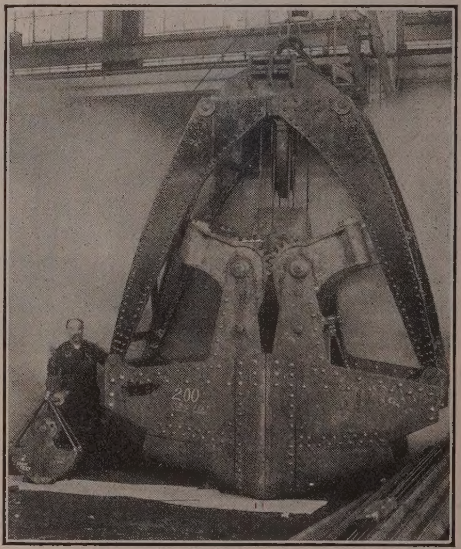
The Holt Manufacturing Company, Peoria, Ill. Circulars showing the Holt "caterpillar" in use on highways and on farms.

American Sheet & Tin Plate Company, Pittsburgh. Booklet, 8 x 11 in.; 20 pages; illustrated. Picturizes uses of "Apollo Best Bloom" and "Apollo-Keystone" copper steel galvanized sheets. Contains tables of standard sizes, showing weights per square foot, per sheet and per bundle, and number of sheets in one bundle.

Buffalo Municipal Equipment Company, Buffalo. Catalogue E. B. listing that company's compressed air hand sprinkler, combined trap and emergency outlet, portable pipe-line street flusher and other products.

Allis-Chalmers Manufacturing Company, Milwaukee. Bulletin 1810, 8 x 10½ in.; 12 pages; illustrated. Describes all-steel jaw crushers for reducing rock.

Wallace & Tiernan Company, Inc., New York. Booklet entitled "Protecting the Water Supply of Greater New York." Size 6¾ x 9¾; 24 pages; illustrated. Describes chlorine-control apparatus for purification of water supply.



200-CUBIC FOOT BUCKET FOR HANDLING ORE

Searchlight Company, Chicago. Booklet, 6 x 9 in., 32 pages. Information on welding and cutting of metals by oxyacetylene process, and equipment.

American Lava Company, Chattanooga, Tenn. Catalog 19, 6 x 9 in.; 24 pages. Describes and illustrates various styles of acetylene-gas tips and burners. Description in French, Spanish and English.

Stow Manufacturing Company, Binghamton, N. Y. Bulletin 100, 6 x 9 in.; 20 pages. Catalogs and illustrates electric motors. Also Bulletins 101 and 102, describing electrically driven drills, grinders and buffers and flexible shafts.

Clarage Fan Company, Kalamazoo, Mich. Folder, 6 x 9 in., 24 pages, illustrated. Describes multiblade fan for heating and ventilating installations.

National Transit Pump & Machine Company, Oil City, Pa. Bulletin 201, 6 x 9 in.; 20 pages; illustrated. Lists National Transit horizontal duplex piston power pumps.